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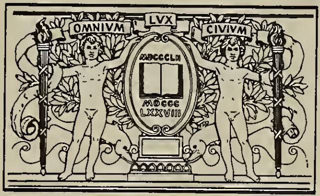

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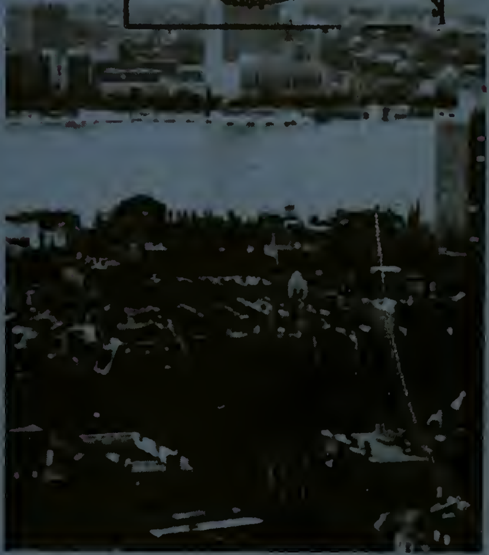
LOWER CHARLES RIVER BASIN



PRELIMINARY REPORT

Metropolitan Area Planning Council
Water Quality Project

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LOWER CHARLES RIVER BASIN

PRELIMINARY REPORT

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Four other appendices to the Lower Charles Basin Report are available upon request. Please order by appendix and chapter numbers below.

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A	2	Background information to "Description of the Lower Charles Basin" in chapter 2.
B	4	A schematic diagram of the construction grants process and a description of the waste flow generation methodology with figures by community.
C-1		A description of the 208 Environmental Pattern Methodology and use.
D	5	A detailed analysis of the alternative water quality management programs summarized in Chapter 5.

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FOREWORD

ABOUT THE MAPC WATER QUALITY PROJECT

The Metropolitan Area Planning Council is Greater Boston's officially designated regional planning agency. Its membership consists of 101 cities and towns, 11 state agencies and 21 gubernatorial appointees.

In 1975 MAPC was selected by Governor Michael S. Dukakis to conduct a $2.3 million water quality improvement project involving 92 of its member communities. The project is entirely funded by the U.S. Environmental Protection Agency which is overseeing a $16 billion nationwide water clean-up project under the Water Pollution Control Act Amendments of 1972.

The study identifies sources of water pollution and establishes alternative actions to correct existing problems and to prevent future degradation of the region's water quality. Following an extensive public review and comment process, selected alternatives are expected to be implemented at the local, regional and state levels to meet federally mandated, nationwide clean water goals.

The most critical issue addressed by this effort is that water quality, land development and growth management are fundamentally related. Any action, or inaction, affecting one will inevitably and eventually affect the others.

Chapter 1

208 Planning and the Lower Charles Basin

CHAPTER 1 208 PLANNING AND THE LOWER CHARLES RIVER BASIN

In this chapter you will find:

- A. An introduction to 208 planning and the federal law (P.L. 92-500) which mandated it;
- B. A brief description of the contents and purpose of this report;
- C. Some basic facts about water quality planning in the Lower Charles River Basin;
- D. A note on how your response to this report can influence decisions in the Lower Charles River Basin;

A. MAPC "208": LOCALIZING NATIONWIDE WATER QUALITY GOALS

> "The objective of this Act is to restore and maintain the chemical, physical and biological integrity of the Nation's waters, in order to achieve this objective it is hereby declared that, consistent with the provisions of the Act--
>
> ...it is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985;
>
> ...it is the national goal that, wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish and wildlife and provides for recreation in and on the water be achieved by July 1, 1983..."

The U.S. Congress established those goals for the nation when it passed the most significant piece of environmental legislation in our history, the Water Pollution Control Act Amendments of 1972 or Public Law 92-500.

To help achieve the goals, the Act was funded at $16 billion over five years to support the construction of municipal wastewater treatment facilities. The Act also established the National Pollutant Discharge Elimination System (NPDES) which required municipal and industrial polluters to obtain a permit to discharge wastes to the nation's waters. The permits, issued by the states and the U.S. Environmental Protection Agency, set conditions and schedules for eliminating pollution discharges. And the Act requires the recipients to pay for wastewater treatment services through user charges and industrial cost recovery.

But in section 208, Congress took its most innovative and forward-looking step. Section 208 established areawide water quality planning programs across the nation. Section 208 planning is unique in many ways:

- The 208 plans must deal with the well recognized point sources of pollution (those that come from a pipe) and with non-point sources (pollution from diffuse causes such as failing septic systems, leachate from landfills, stormwater runoff from streets, etc.);

- The plans must deal with means of preventing pollution as well as means of cleaning it up;

- The plans must be areawide in scope and deal with problems that cross municipal borders;

- The plans must be written with full citizen participation and make use of the public's wishes to the greatest extent possible; and

- The plans must identify the means of their implementation and establish an areawide management system to update and carry out plan recommendations through 1995.

The MAPC's Water Quality Project is now engaged in a 208 planning program for one of the largest and most diverse planning areas in the nation. It involves 92 of the MAPC's 101 cities and towns and nine separate river basin plans. A population of nearly three million people will be effected by the results.

B. THIS REPORT

This preliminary basin report is a critical step in the planning process. It is the single best opportunity for the citizens and public officials of the area to influence the results. That participation is essential because of the nature of this plan. The MAPC staff has not made all of the choices for you. They have presented the information you will need to participate in the decisions regarding your community and region. That information includes:

- the identification of existing sources of water pollution and those pollution sources that await in the future if we fail to act to prevent them, as well as the identification of present water quality and the goals established for the future;

- the presentation of alternative means of correcting and preventing water pollution problems in the basin;
- an assessment of the likely impacts or results of the alternative solutions and a discussion of the major issues to be resolved;
- an analysis of the management implications for local, multi-local, areawide, state and federal governments responsible for implementing the water quality solutions.

C. SOME BASIC FACTS

There are a few important facts which have determined the scope and direction of the MAPC Water Quality Project. It may be helpful to have them in mind as you read this Preliminary Lower Charles River Basin report.

- Our present pattern of growth and development in the Lower Charles River Basin has contributed to the increase in water pollution and to the cost of cleaning it up. Future growth decisions can and must consider water quality impacts.
- As the state/federal NPDES permit programs gradually reduce point source municipal and industrial pollution, the challenge is shifting to control of non-point pollution to achieve fishable and swimmable water.
- Much of the authority to deal with present and future pollution problems lies with local governments which can build and operate treatment works, exercise land use and subdivision controls, set and enforce public health regulations, etc. But wider state involvement is likely if local governments are unable to act.
- Many water quality problems are predictable and preventable. The 208 project's method of identifying undeveloped areas with potential septic system failures has been verified by comparison with developed areas in the basin where failures have occurred. Also, chloride levels in reservoirs predictably parallel increases in state and local salt use.
- The existence of wastewater treatment facilities in the basin has not been an answer to all water quality problems. It may create others by discharging improperly treated effluent, sludge generation, inducement of unplanned growth, etc.
- While this report will indicate areas for additional sewering, it will also show some lower cost options

for retaining existing on-lot septic systems and siting new development on septic systems.

- It is cheaper and easier to prevent water pollution problems than to correct them, The citizens of Massachusetts now pay about a million dollars a week to clean up water pollution, according to Environmental Protection Agency estimates.

- Water for household, industrial and recreational use in the metropolitan area is not in unlimited supply. As we use or waste or pollute more of our water resources, our water costs will go up and the quality of our lives will go down.

D. PLAN REVIEW AND APPROVAL

The MAPC water quality staff urges all local town officials and interested citizens to read and respond to these preliminary basin reports because an analysis of their comments and questions serves as a major project guide for refining locally preferred management options and implementable solutions. Local officials in most, if not all of the 92 communities have contributed and verified data used by staff to develop these preliminary basin reports. Those readers who now participate in this process have an opportunity to react to and assess the feasibiltiy of implementing solutions presented and by so doing to effectively influence the areawide water quality management plan of which these basin reports for the skeleton.

Roles in Decision Making

The decision-making process involves:

- the Technical Advisory Committee - responsible for formal action upon "a plan of study including work elements, agency task assignments, consultant assignments, and 208 fund allocations to elements in accordance with EPA guidelines. The approval and advice of the technical subcommittee will be sought during the execution of the plan of study and in the final plan selection.

- Areawide Planning Advisory Committee - a policy advisory committee established to advise the MAPC during the development of the areawide plan on broad policy matters, including the fiscal, economic, and social impacts of the plan.

- Citizens Advisory Committee - an advisory committee of interested citizens who review and comment on technical/ management staff reports, the comments of citizens on the planning process, and the public participation efforts.

- Citizens/local officials throughout 92 Boston metropolitan area cities and towns, the Executive Director, the Executive Committee of MAPC - responsible for providing overall direction and policy guidance. The final decision-making body for the agency.

The MAPC 208 water quality staff, the state's Department of Environmental Quality Engineering, the Governor, and the United States Environmental Protection Agency will also play important roles described below.

The MAPC water quality staff work to gather and develop data into preliminary basin reports; urge and encourage public review and comment on them; respond to comments and questions raised by advisory committees and the basin public/local officials during the review process.

An early written response process for these preliminary basin reports permits staff to write narrative summaries of comments received. The advisory committees and the basin public/local officials receive, when possible, this information, which may present community-oriented perspectives different from their own, prior to the public meeting to discuss their basin report.

Subsequest to the basin report public meetings, the staff reviews and synthesizes all written comments, as well as the tapes of comments made at the basin meetings and prepares responsive analytical summaries highlighting key points.

The basin reports, accompanied by an addendum consisting of an errata sheet as well as this analysis of reader responses are submitted for formal state review to the Department of Environmental Quality Engineering for their recommendations, and simultaneously to the Executive Director/Executive Committee for their formal recommendations. Copies of these "Analytical Summaries" are provided to involved citizens and local officials as well as to the aforementioned advisory committees.

The Importance of Basin Report Review in Decision Making

The Executive Committee of MAPC has an obligation prior to making its recommendations to consider all substantive points made on the preliminary basin reports. A summary of the Executive Committee's responses will be made and distributed to previously involved basin public/local officials and advisory committees in order to delineate what was considered important to include or modify or which had not been given prominence and/or dealt with satisfactorily by others in the process.

The Executive Committee and formal state (DEQE) recommendations on the individual revised basin reports will be studied by the water quality staff as they develop the draft for the areawide water quality management plan.

The Areawide Plan and Responsibilities

The water quality staff is responsible for: developing the areawide water quality management plan; conducting the public review of that plan; processing and analyzing commentaries received; and submitting analytical summaries to the advisory committees and to its decision-making Executive Committee for approval and recommendations.

Once the areawide water quality management plan, cognizant of all previous input, is approved by the MAPC Executive Committee, it will be available for public review and comment. Prior to submitting the areawide plan to the state for formal review, MAPC is required to provide the governing bodies of local governments having responsibility for, or which would be directly affected by, implementation of the plan and having jurisdiction in the planning area, an opportunity to comment on the plan and proposed management agency(s) and make recommendations for approval or disapproval. In the event that a local unit of government fails to provide a recommendation within the review period provided, the agency (MAPC) may consider that the plan has been favorably recommended by that unit of local government. The local recommendations and comments are forwarded with the areawide plan submitted to DEQE for formal review and recommendations on certification.

Subsequent to formal state review, the staff bears the responsibility for responding to state recommendations/deficiencies on the draft areawide plan. The MAPC and MDC shall jointly recommend the final 208 plan to the Governor. Based on the formal state review and recommendations and the recommendations received from local units of government, the Governor must determine whether to approve or disapprove all or portions of the plan. If the Governor approves the areawide water quality management plan, he must then forward it to the EPA Region I Administrator with certification of approval and proposed designation of management agency(s) along with the recommendations received from the local units of government. If the plan is disapproved, the Governor must notify the EPA and the MAPC specifying how the plan or portions thereof must be modified to receive approval. The staff bears the responsibility for making modifications for approval.

To assure that the approved and certified areawide water quality management plan remains relevant and workable within changing conditions, it requires continued updating and annual certification. The upgrading process is, of course, also subject to public participation activities.

Action Handbook

To facilitate commenting by readers, an ACTION HANDBOOK accompanies this report. This handbook is meant to encourage your written comments on this preliminary basin report by presenting a series of tables and questions for your consideration and evaluation. It assumes you have read the report.

Conclusion

You are about to participate in a public meeting of vital importance in the development process of the areawide water quality management plan for the Boston metropolitan area. We are near the end of one phase in the planning process but we are meeting well in advance of the making of recommendations to decision-makers. There will probably not again be a time when the subjects included within this meeting will be of greater interest to or more carefully scrutinized by you.

You are invited, near the end of the planning process probably in February-March, to provide definitive comments on the areawide plan recommendations derived from the basin reports. What we accomplish during the public review period for this basin report will significantly impact those ultimate recommendations.

On behalf of the water quality project staff, we thank you for your continued interest, time, and cooperation in helping us make the areawide plan equitable, effective, and acceptable.

Chapter 2

Lower Charles Basin Overview

CHAPTER 2 LOWER CHARLES RIVER BASIN OVERVIEW

In this chapter, you will find:

A. A brief profile of the basin, its communities and natural characteristics;

B. A listing of the basin's water quality problems;

C. A note on the solutions we will be considering;

D. A summary of physical description of the Charles River and water quality standards and classifications.

A. A PROFILE OF THE LOWER CHARLES BASIN

The Lower Charles Basin, along with the Mystic River Basin, forms the core of the Boston metropolitan region. The Basin includes the lower reaches of the hour-glass shaped Charles River Watershed which extents south west of the core. As shown in Figures 1, 2 and 3, fourteen communities, including Boston, lie largely or wholly within the Lower Charles Basin. They are:

Belmont
Boston
Brookline
Cambridge
Dedham
Lexington
Lincoln
Natick
Needham
Newton
Waltham
Watertown
Wellesley
Weston

Three other communities which lie partially within the watershed may be mentioned in this report, but they are discussed in fuller detail in other basin reports. These are:

- Somerville in the Mystic River Basin Report,
- Wayland in the SuAsCo Basin Report, and
- Westwood in the Neponset Basin Report.

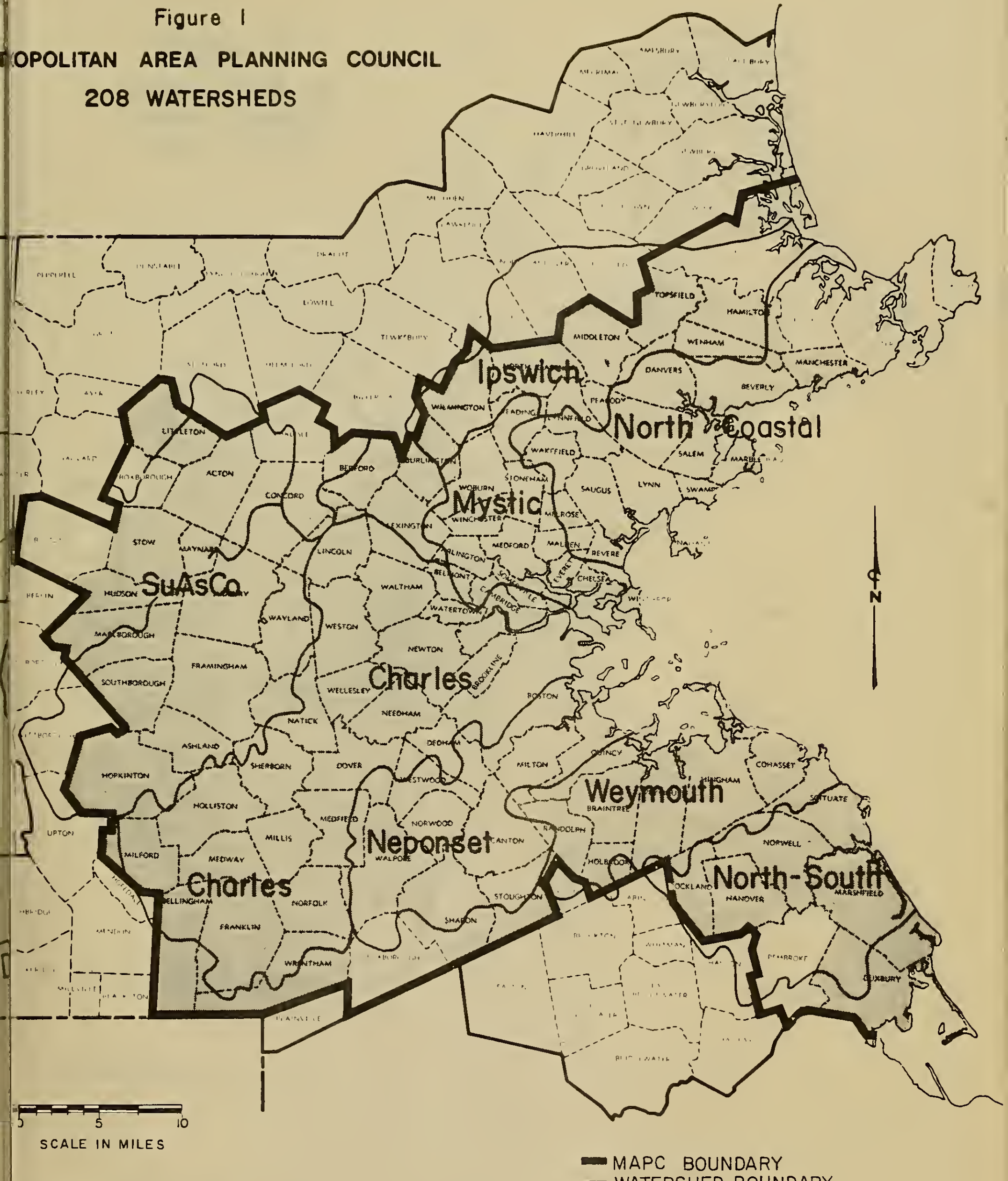
The Lower Charles Basin includes both intensely developed core communities including Boston and Cambridge, stable inner suburbs including Belmont, Dedham and Newton, and a few outlying suburbs such as Lexington, Lincoln and Weston. Historically, the basin communities were among the earliest developed in the region.

As seen in Table 2-1, from 1950 to 1970, the exodus of residents from the core area to the suburbs is most apparent. While Boston and Cambridge lost a substantial portion of their populations, Lexington and Weston doubled in population and Lincoln tripled in population. The other basin communities either grew by only a small percentage or grew moderately (between 30 and 40 percent). Population in the basin as a whole is expected to stabilize between 1970 and 1995, with

Figure I

OPOLITAN AREA PLANNING COUNCIL

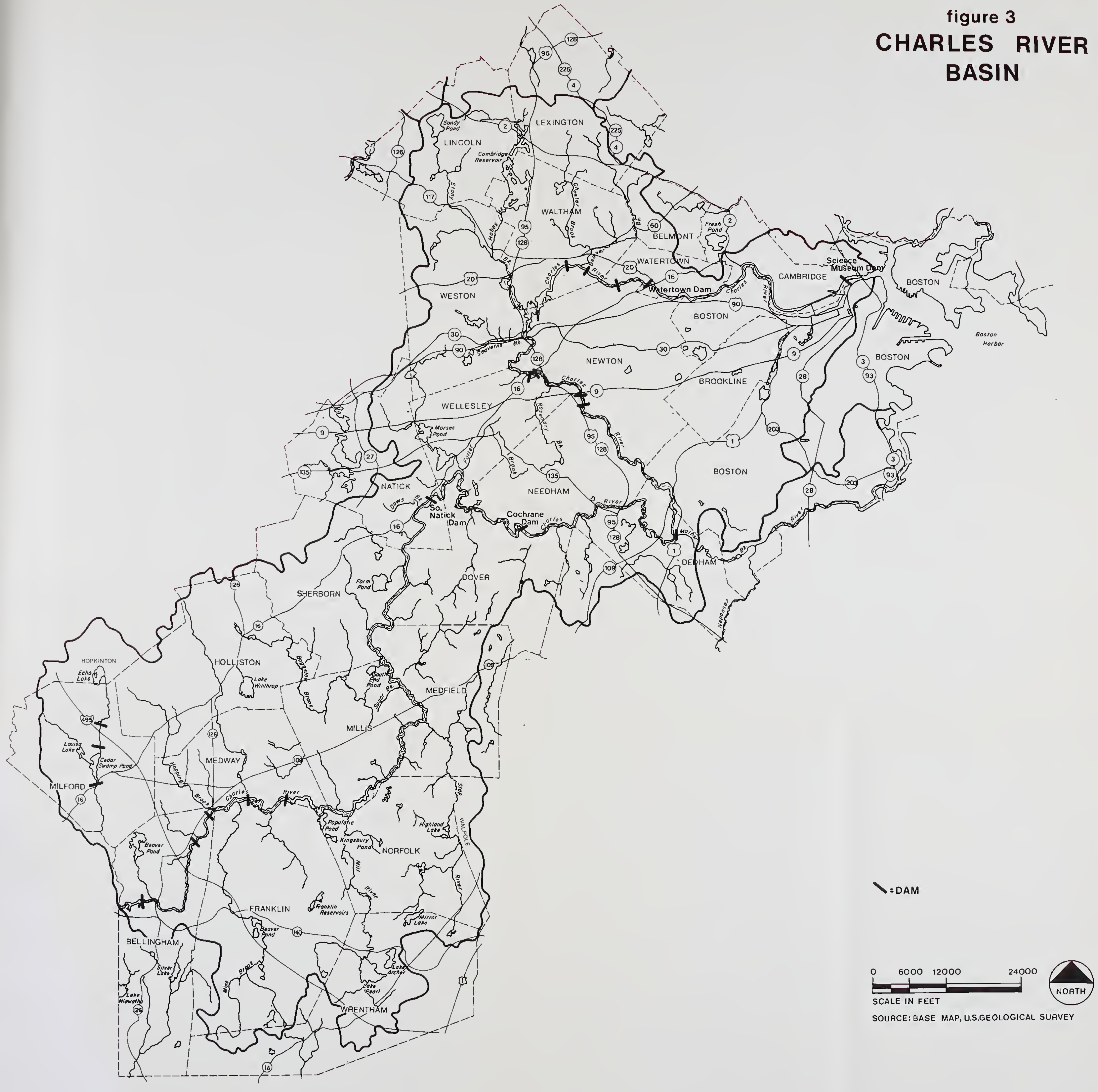
208 WATERSHEDS



ROLITAN AREA PLANNING DISTRICT
ED TO PRESENT SIZE CHAPTER 588, ACTS OF 1966
LEGISLATION CHAPTER 668, ACTS OF 1963

MAY, 1976.

figure 3
CHARLES RIVER BASIN



SOURCE: BASE MAP, U.S.GEOLOGICAL SURVEY

TABLE 2-1

CHANGES IN COMMUNITY POPULATIONS AND PROJECTIONS: LOWER CHARLES

AREA	1950[1]	1960[1]	% Change '50 '60	1970[2]	% Change '60 '70	% Change '50 '70	1975[3]	1980[4]	1985[4]	1990[4]	1995[4]	% Change '70-'95
BELMONT	27,381	28,745	4.9	28,285	-1.6	-3.3	27,500	27,600	28,000	28,000	29,200	3.2
BOSTON	801,444	697,197	-13.0	641,071	-8.1	-20.0	639,000	635,000	634,000	638,000	638,000	-0.48
BROOKLINE	57,589	54,044	-6.2	58,886	8.9	2.3	59,000	61,800	62,100	62,300	62,000	5.3
CAMBRIDGE	120,740	107,716	-10.8	100,361	-6.8	-16.9	102,000	104,000	104,900	105,300	105,500	5.1
DEDHAM	18,487	23,869	29.1	26,938	12.9	45.7	26,900	27,600	27,800	27,900	28,000	3.9
LEXINGTON	17,335	27,691	59.7	31,886	15.1	83.9	32,500	34,300	35,000	35,600	36,000	12.9
LINCOLN	2,427	5,613	131.3	7,567	34.8	211.8	6,500	6,400	7,000	7,700	8,800	16.3
NATICK	19,838	28,831	45.3	31,057	7.7	56.6	31,100	31,800	33,000	34,300	35,100	13.0
NEEDHAM	16,313	25,793	58.1	29,748	15.3	82.4	30,000	30,300	31,200	32,100	32,800	10.2
NEWTON	81,994	92,384	12.7	91,066	-1.4	11.1	89,200	89,800	90,000	90,500	91,500	0.5
WALTHAM	47,187	55,413	17.4	61,582	11.1	30.5	56,800	56,500	57,800	59,500	61,000	-0.9
WATERTOWN	37,329	39,092	4.7	39,307	0.55	5.3	36,000	35,200	35,600	36,500	37,800	-3.8
WELLESLEY	20,549	26,071	26.9	28,051	7.6	36.5	26,600	27,900	27,400	27,500	27,500	-2.0
WESTON	5,026	8,261	64.4	10,870	31.6	116.3	11,500	12,500	13,500	14,000	14,500	22.4
TOTAL	1,273,639	1,220,720	-7.2	1,195,675	-2.1	-6.1	1,174,600	1,180,700	1,187,300	1,201,000	1,207,700	1.0

[1] U.S. Census of Population
[2] U.S. Census of Housing
[3] State Census
[4] CTPS Projections

little or no growth for most communities. Weston is expected to have the fastest rate of population increase, 33.4 percent, although this rate is significantly less than what occurred in the town between 1950 and 1970.

Overall, employment in the Lower Charles is expected to increase by 26 percent between 1975 and 1995. See Table 2-2. Economic growth is expected to continue in the majority of sectors through 1995. The most substantial increases in employment are expected in the Services and Construction sectors (74 and 64 percent, respectively), followed by the Finance, Transportation and Government sectors. Employment in the Trade sector is expected to decrease somewhat, while moderate to substantial decreases are expected in the Agriculture, Non-Classified, and Manufacturing sectors (between 20 and 60 per cent). In 1975, 78 percent of the manufacturing jobs were in "dry" manufacturing, and 22 percent were in water intensive, "wet" and "very wet" manufacturing activities. These proportions would remain the same by 1995. However, as mentioned above, manufacturing employment is expected to decline in the next twenty years. In 1975, it represented 16 percent of total employment and by 1995 it would represent only 9 percent of all jobs. By 1995, roughly two-thirds of the jobs in water-intensive industries will be found in Boston, with the remaining distributed throughout most of the other Basin communities (except Lincoln).

Housing construction in the Lower Charles Basin has ranged from a predominance of multi-family housing units in the core area, to a mixture of single- and multi-family housing units in the inner suburbs, to a predominance of single-family housing units on lot sizes varying from one-quarter acre to one acre in the outerlying suburbs. Generally, the housing stock in the basin is relatively old, much of it having been built prior to 1950. As of 1971, residential land uses constituted 38.2 percent of the total 149,097 acres in the basin.

Projections of future housing construction activity indicate that approximately 8600 new dwelling units would be built between 1970 and 1995. Since roughly 90 percent of the Basin is already developed or preempted from development*, much of the new development would involve the conversion of land already in urban use, rather than construction on previously undeveloped acreage.

Commercial and industrial land use has historically been concentrated in the core area, in Boston and Cambridge, in particular. Increases in commercial acreage between 1951 and 1971 occurred in all the basin communities and in particular, along major transportation routes (such as Route 9 in Natick). Boston has seen the most substantial increase in commercial

---

* In the form of semi-public open space, deed-restricted wetlands, water bodies and conservation or floodplain districts.

Table 2-2

TOWN	1975					1980					1985					1990					1995				
	Total Emp.	Mfg. Emp.	% Mfg.	Non-Mfg.	% Non Mfg.	Total Emp.	Mfg. Emp.	% Mfg.	Non-Mfg.	%Non Mfg.	Total Emp.	Mfg. Emp.	% Mfg.	Non-Mfg.	% Non Mfg.	Total Emp.	Mfg. Emp.	% Mfg.	Non-Mfg.	% Non Mfg.	Total Emp.	Mfg. Emp.	% Mfg.	Non-Mfg.	% Non Mfg.
BELMONT	4775	362	7.6	4413	92.4	4800	350	7.3	4450	92.7	5000	320	6.4	4680	93.6	5100	320	6.3	4780	93.7	5300	300	5.7	5000	94.3
BOSTON	483671	54298	11.2	429373	88.8	533000	52500	9.8	480500	90.2	564999	49000	8.7	515999	91.3	600000	45500	7.6	554500	92.4	632000	41000	6.5	591000	93.5
BROOKLINE	15245	307	2.0	14938	98.0	16000	350	2.3	15650	97.7	16500	400	2.4	16100	97.6	17200	500	2.9	16700	97.1	18000	500	2.8	17500	97.2
CAMBRIDGE	85499	18325	21.4	67174	78.6	88000	17000	19.3	71000	80.7	90000	15000	16.7	75000	83.3	93500	13000	13.9	80500	86.1	97000	12000	12.4	85000	87.6
DEDHAM	11190	2538	22.7	8652	77.3	13100	2500	19.1	10600	80.9	15200	2600	17.1	12600	82.9	17500	2600	14.9	14900	85.1	18600	2600	14.0	16000	86.0
LEXINGTON	11078	3738	33.7	7340	66.3	11700	3100	26.5	8600	73.5	12400	2500	20.2	9900	79.8	13100	2000	15.3	11100	84.7	13800	2000	14.5	11800	85.5
LINCOLN	1050	17	1.6	1033	98.4	900	40	4.4	860	95.6	950	40	4.2	910	95.8	1000	40	4.0	960	96.0	1100	50	4.6	1050	95.4
NATICK	15677	3367	21.5	12310	78.5	17500	3500	20.0	14000	80.0	21000	3600	17.1	17400	82.9	25000	3750	15.0	21250	85.0	27600	3700	13.4	23900	86.6
NEEDHAM	13446	3500	26.0	9946	74.0	14200	3000	21.1	11200	78.9	15000	2500	16.7	12500	83.3	15800	2250	14.2	13550	85.8	16700	2000	12.0	14700	88.0
NEWTON	36637	4093	11.2	32544	88.8	37000	3500	9.5	33500	90.5	38000	3000	7.9	35000	92.1	35000	2500	6.4	36500	93.6	40000	2100	5.3	37900	94.6
SOMERVILLE *	20723	3524	17.0	17199	83.0	22600	3400	15.0	19200	85.0	23200	3000	12.9	20200	87.1	23800	2750	11.5	21050	88.5	24500	2300	9.4	22200	90.6
WALTHAM	53502	24508	45.8	28994	54.2	54000	22000	40.7	32000	59.3	54500	20000	36.7	34500	63.3	55000	18000	32.7	37000	97.3	56000	14150	25.3	41850	74.7
WATERTOWN	16450	6965	42.3	9485	57.7	16700	6500	38.9	10200	61.1	16900	6200	36.7	10700	63.3	17200	5750	33.4	11450	66.6	17600	5400	30.7	12200	69.3
WAYLAND *	4384	1896	43.2	2488	56.8	5900	2600	44.1	3300	55.9	7600	3200	42.1	4400	57.9	9400	4000	42.5	5400	57.5	11100	4000	36.0	7100	64.0
WELLESLEY	11086	930	8.4	10156	91.6	12000	950	7.9	11050	92.1	12200	950	7.8	11250	92.2	12800	1000	7.8	11800	92.2	13500	1000	7.4	12500	92.6
WESTON	2891	75	2.6	2816	97.4	2900	275	9.5	2625	90.5	3400	475	14.0	2925	86.0	4000	700	17.5	3300	82.5	4500	650	14.4	3850	85.6
WESTWOOD *	4003	304	7.6	3699	92.4	4700	450	9.6	4250	90.4	5400	550	10.2	4850	89.8	6150	700	11.4	5450	88.6	6900	700	10.1	6200	89.9
TOTALS	791307	128747	16.3	662560	83.7	855000	122015	14.3	732985	85.7	902249	113335	12.6	788914	87.4	955550	105360	11.0	850190	89.0	1004200	94450	9.4	909750	90.6

* Only partly in Basin.

acreage. Increase in industrial acreage has been, since 1951, concentrated in the suburban communities abutting Route 128, including Waltham, Needham and Lexington, as well as Natick. Of the total 149,097 acres in the Lower Charles Basin, about 8 percent is in commercial or industrial land use.

The low residential density found in the western portions of the watershed helps support a variety of wildlife species. Otherwise, those species found in part of Massachusetts are those that have not been forced westward or northward by the heavy pressures of urbanization and those that have adapted to the altered, built environment. Examples include raccoons, rabbits, gulls, and other small mammals and birds. In addition, pigeons and squirrels seem to have adapted quite well to the urban environment. Natural landscape features in the basin include the Olmsted park system in the core area of the basin and sections of meandering streams, farmlands, water bodies, wooded uplands and drumlins in the outerlying sections of the basin. (For a more detailed description of the Lower Charles, see Appendix A.)

B. A LIST OF WATER QUALITY PROBLEMS

The first step in development of a management plan for the Lower Charles Basin is to identify the factors that are damaging or threatening water quality. Here is a brief listing in no particular order, of the most important problems in this Basin. Although the problems are listed separately, there are relationships among many of them which will become clearer later in the report. (These problems are discussed in more detail in Chapter 3.)

Wastewater Treatment Facilities - Two large primary treatment facilities in Boston Harbor discharge their effluent into the ocean. The two treatment facilities located on Deer Island and Nut Island are operated by the Metropolitan Sewerage District - and serve a total of 43 communities. Improvements to the existing system were recommended by the Eastern Massachusetts Metropolitan Area (EMMA) Study and construction priorities were established over a 10-year construction period. Apart from the Boston Harbor treatment facilities, there are a number of small scale private and public treatment plants in the basin.

Combined Sewer Discharges - This is a major source of pollution in the lower reaches of Charles River and Boston Harbor. Combined sewers serve about 50 percent of the MDC served population covering about one-fifth of the sewered area tributary to the MSD northern sewerage system with overflows of combined sewerage occurring in over 100 locations. Five communities namely Boston, Brookline, Cambridge, Chelsea and Somerville are served by a combined sewer system. Boston, and Cambridge have on-going projects for separation of the combined system. Sewer separation program recently completed in Brookline has reduced the percentage of the town served by combined sewers to approximately 10 percent.

Industrial Discharges - Sixteen industries in the Lower Charles Basin have received NPDES permits to discharge wastewater in the basin (list in Chapter 3). The permits specify conditions and improvement schedules for the dischargers. Some permits are still unissued or not required but none of these dischargers has been identified as a pollution source.

Septic Systems - More than 22 percent of the entire Charles River Basin residents are served by septic systems and cesspools, but in the Lower Charles Basin, percentage of residents using such systems is only five. Some of these units are experiencing problems because of improper siting, installation or maintenance. A look at local zoning indicates that some towns are now permitting development uses and densities in locations that are likely to result in future failures, pollution and unwanted and costly sewering.

Stormwater Runoff - Rain runoff and snow melt from streets, buildings and parking lots carry dirt, oil, fertilizer and organic wastes into waterbodies in developed areas. Since Lower Charles Basin is highly urbanized with at least 48 percent urban land, this type of pollution has a severe impact on water quality in this basin. The only exceptions are the towns of Lincoln and Weston which are very much like the Upper Charles communities, i.e., rural in nature. Corrective measures are needed. The best urban runoff control is prevention through proper land use management wherever applicable in this basin. Structural solutions like storage and treatment schemes are very costly and entail technical and economical problems.

Landfills - If a landfill is poorly located or operated, rainwater will pass through the fill and carry out a highly toxic mixture of pollutants called leachate. The leachate damages ground and surface water resources sometimes miles away.

Majority of the disposal sites are poorly located adjacent to, and in some cases, within, wetlands or surface waters. Some have been cited for violations numerous times. Several landfills have long been notorious as pollution sources of the main stem of the Charles River. Recently some improvements have been reported and are described in Chapters 3 and 4 of this report.

Road Salt - Pollution from improper salt storage is being eliminated, but the continuing excessive application of road salt in the Charles River Basin poses a threat to some surface and groundwaters. Some correction is underway, but more improvement is needed by state and local officials.

Sludge Disposal - Sludge disposal sites should be located away from wetlands and surface waters and should have adequate depth to the groundwater table and/or bedrock.

Currently, digested sludge from the primary treatment plants in Boston Harbor is being discharged to the outer harbor on outgoing tides. MDC's sludge management plan calls for incineration and is the subject of a full environmental impact statement (EIS) by EPA. The Draft EIS is expected to be published by the end of November, 1977. Sludge from small scale private or public treatment facilities is disposed of locally as landfill.

Septage Disposal - Nearly 21 million gallons of septage is generated each year from septic tanks and cesspools in the Charles River Basin towns. Approximately 68 percent of this quantity is disposed of to the MSD system. About 7 million gallons/year comes from MSD member communities and the rest from non-member communities. Lincoln and Weston are the only two non-member communities in this basin discharging septage to the MSD system.

Loss of Critical Areas - Development in the Charles River Basin has taken its toll in terms of filled marshes and wetlands, developed floodplains and loss of groundwater recharge areas.

Although pressure by land developers remains strong in the upper watershed, encroachments on wetlands have particularly taken place in the lower watershed. The U.S. Congress has designated seventeen wetland "natural valley storage areas" in the watershed to be protected from development through public ownership. This is a result of a recent study by the U.S. Army Corps of Engineers (1972) which found this to be the most cost-effective flood-control measure for the Charles River.

C. THE SOLUTION

It is the role of the 208 program to find implementable solutions to the problems that have been identified. These solutions may be structural, that is, requiring the construction of sewers, treatment facilities, etc., or they may be non-structural, such as stricter health regulations to control the siting of septic systems or land use controls to protect environmentally sensitive areas. Some of the solutions will be clearly indicated by the nature of the problems, but some will not. Some solutions will be indicated by community goals and policies, such as a master plan to develop and sewer a particular area while saving another area for open space. But, in many situations there will be no clear policy and the choice of a water quality solution may influence the future of a community including its rate, density and type of growth, taxes, services, economic development and general character. This is the case when a community must choose between sewering an area with failing septic systems or establishment of a strict inspection and maintenance/reconstruction program. It is also the case when a community must choose between preventive action in the form of planning and regulation before a problem develops or expensive corrective action later on.

The most appropriate choice is the one which a community understands and will implement. Because much of the responsibility for implementing solutions rests with local governments, local officials and citizens will play a major role in development and selection of solutions.

As we use this report to seek out the most appropriate solution for your basin and your community, try to see the connections among solutions. View the actions to solve or prevent water pollution as part of an overall program. For example, when considering sewering extensions, be aware of the implications for the remaining unsewered areas and the need to review their land use and health regulations at the same time. Relate this issue of septage treatment to the possible need for regular inspection and maintenance of septic systems. Consider water needs in your community and throughout the basin when you decide on how aquifer recharge land will be used. And, view the entire set of solutions in light of your community's desired pattern of growth and its ability to accommodate its anticipated growth pressures without damage to our environment.

D. A SUMMARY OF PHYSICAL DESCRIPTION OF THE CHARLES RIVER AND WATER QUALITY STANDARDS AND CLASSIFICATIONS

The Charles River begins its 80 mile journey to Boston Harbor above Echo Lake in Hopkinton. The Charles squeezes its 80 mile length into a watershed which measures some 30 miles long and varying from 5 to 15 miles wide in an hour-glass configuration by taking a twisting, meandering path through its 307 square mile drainage area. The Indian name for the Charles River was Quinobequin, which means twisting or winding.

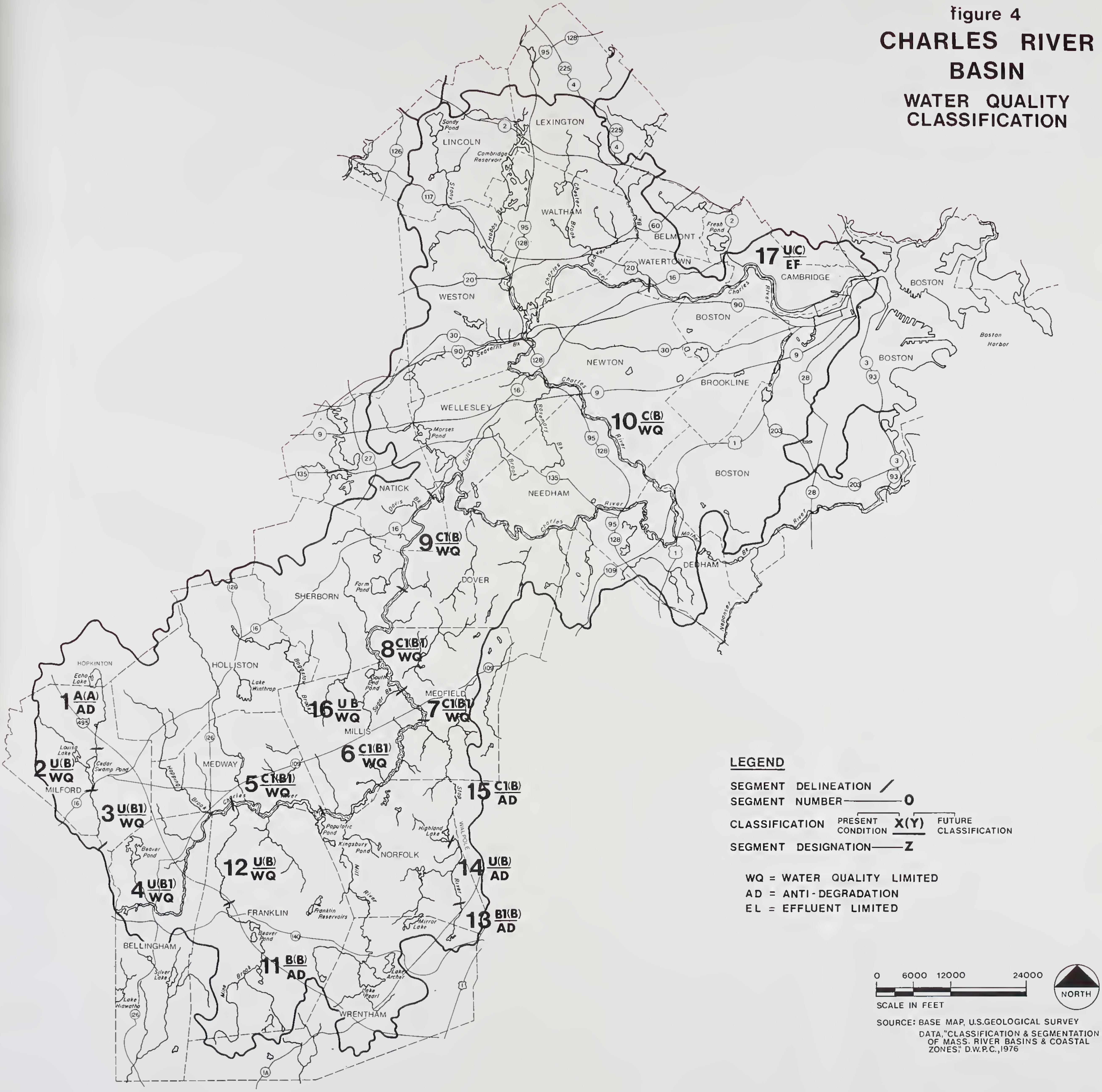
There are 33 lakes and ponds having a total surface area of 2530 acres. Numerous backwater ponds have been created along the length of the river by the 21 dams found on the river. There are some 30 tributaries of the Charles and two diversions. Mother Brook diverts up to one-third of the Charles flow to the Neponset River. Water is diverted from the Hobbs Brook-Stony Brook tributary system for the Cambridge water supply. About 20,000 acres (one-tenth the basin's total acreage) is comprised of extensive upland swamps and wetlands.

The Charles River and its three major tributaries, presently receiving significant wastewater discharges, are divided into seventeen water quality segments. The segmentation is determined by points of present or planned major wastewater discharges and by changes in future use classifications. Water quality classifications are shown on Figure 4. Definitions of water quality standards and segment classifications are presented on Table 2-3 and 2-4.

figure 4

CHARLES RIVER BASIN

WATER QUALITY CLASSIFICATION



SOURCE: BASE MAP, U.S.GEOLOGICAL SURVEY
DATA, "CLASSIFICATION & SEGMENTATION OF MASS. RIVER BASINS & COASTAL ZONES," D.W.P.C., 1976

Table 2-3
MASSACHUSETTS WATER QUALITY STANDARDS
As Defined by the Division of
Water Pollution Control, May, 1974

Fresh Water

Class A - Designated for use as sources of public water supply.

Class B - Suitable for bathing and recreational purposes, water contact activities, acceptable for public water supply with treatment and disinfection, are an excellent fish and wildlife habitat, has excellent aesthetic values and suitable for certain agricultural and industrial uses.

Class B1 - Use and criteria for Class B1 is the same as for Class B with the exception of the dissolved oxygen requirement.

Class C - Suitable for recreational boating and secondary water contact recreation, as a suitable habitat for wildlife and fish indigenous to the region, for certain agricultural and industrial uses, has good aesthetic values, and under certain conditions is acceptable for public water supply with treatment and disinfection.

Class C1 - Use and criteria for Class C1 is the same as for Class C with the exception of the dissolved oxygen (and temperature) requirements.

Class U - Water quality does not meet any of the above standards.

TABLE 2-3: MASSACHUSETTS WATER QUALITY STANDARDS (Cont'd)

Salt Water

Class SA -

Waters of the highest quality and are suitable for any high water quality use including bathing and other water contact activities. Suitable for approved shellfish areas and the taking of shellfish without depuration, have the highest aesthetic value and are an excellent fish and wildlife habitat.

Class SB -

Suitable for bathing and recreational purposes including water contact sports and industrial cooling, have good aesthetic value, are an excellent fish habitat and are suitable for certain shell fisheries with depuration (Restricted Shellfish Areas).

Class SC -

Suitable for aesthetic enjoyments, for recreational boating, as a habitat for wildlife and common food and game fish indigenous to the region, and are suitable for certain industrial uses.

TABLE 2-4

EFFLUENT LIMITATIONS BY SEGMENT CLASSIFICATIONS

Following the enactment of PL 92-500, the Environmental Protection Agency required all States to classify all the surface waters of every state according to whether base level effluent limitations required under the Act will be sufficient to meet the water quality standards in a particular stream segment. The three classifications, or designations, are defined as follows:

Effluent Limited Segment -

Any segment where it is known that water quality is meeting and will continue to meet applicable water quality standards or where there is adequate demonstration that water quality will meet applicable water quality standards after the application of required effluent limitations.

Water Quality Limited Segment -

Any segment where it is known that water quality does not meet applicable water quality standards and/or is not expected to meet applicable water quality standards even after the application of required effluent limitations.

Anti-Degradation Segment -

Each State must develop and adopt a Statewide anti-degradation policy in the water quality standards. Massachusetts' Anti-degradation Policy is:

> No new discharge is permitted upstream of the most upstream existing municipal dishcarge. (This policy is enforcable through the general provisions of the Massachusetts Water Quality Standards.)

There are ten main stem segments, two for Mine Brook, three for Stop River, one for Sugar Brook, and one for Charles Basin (the main stem portion below the Watertown Dam).

The present water quality condition in fourteen segments is below B. According to DWPC's (Division of Water Pollution Control) latest reclassification, water quality goal for the entire Charles River Basin is "swimmable and fishable" water. However, at present, the classification of the Charles Basin (the main stem portion below the Watertown Dam) remains class C - "fishable" but not "swimmable".

The Charles flows south from Echo Lake into Milford. Water quality down to Dilla Street in Milford is classified Class A due to its use as a public water supply. This is the only stretch of the river currently meeting water quality standards. This segment has been designated as Anti-degradation by the DWPC.

From Dilla Street, the river flows into Cedar Swamp Pond. The Pond is a shallow, eutrophic impoundment, choked with aquatic weeds and high algae levels. Nutrient levels were found to be moderately high and dissolved oxygen low. Pollution sources include raw sewage discharges from overflows and bypasses in the Milford sewer system and the old Milford dump located on the bank of the pond. This segment has been designated Water Quality Limited with a present water quality classification of U. This means that the water quality in this section does not meet any of the criteria for any of the state's allowable water quality use classifications. The water quality goal for this section is Class B.

In the next section of the river, from Main Street to the Milford Sewage Treatment Plant, water quality conditions remain the same for much the same reasons. The water quality goal in this segment is Class B1. Criteria for Class B1 are the same for Class B with the exception of the dissolved oxygen criteria.

The segment of the Charles from the Milford Wastewater Treatment facility to Mine Brook in Franklin is one of the three most severely polluted segments in the Charles River. Water quality conditions are characterized by extremely low dissolved oxygen levels, toxic ammonia levels, high nutrient levels and high bacterial contamination. In this ten mile stretch of the river, the river is joined by three tributaries as it turns east through North Bellingham, then northeast through Bellingham, Medway and Franklin. Beaver Brook drains portions of Milford and Bellingham. Stall Brook drains portions of Milford, Medway and Bellingham. Hopping Brook, a major tributary, drains portions of Holliston, Hopkinton, Medway and Bellingham. The segment has been designated Water Quality Limited, and of U water quality with a future goal of Class B1.

From Mine Brook the Charles flows east forming the border between Franklin and Medway to Populatic Pond. The river is joined by three tributaries in this segment. Mine Brook, which drains portions of Wrentham and Franklin, Chicken Brook, draining portions of Hopkinton, Holliston and Medway, and Shepards Brook, which drains a relatively undeveloped section of Franklin. Mine Brook itself is broken into two segments as the Franklin Sewage Treatment Plant is located four miles upstream from the river. Upstream of the treatment plant, water quality meets Class B criteria. Downstream from the treatment plant constitutes the second of the three most grossly polluted segments in the Charles Basin. Current water quality conditions are of Class U with a future classification of Class B. The water quality of the Charles in this segment is of Class C, with a future goal of Class Bl. Pollution sources in this segment, include Mine Brook (due to the impact of the Franklin STP), the Broad Street Sewer overflow in Medway, failing septic systems in Franklin, and the discharge from "Your Laundry" in Medway.

The Charles flows eastward from Populatic Pond to its confluence with the Mill River where it turns northward through Norfolk, Millis, and Medfield to its confluence with the Stop River in Medfield. The Mill River drains portions of Wrentham, Franklin and Norfolk. The Stop River drains portions of Wrentham, Walpole, Norfolk and Medfield. The river is able to recover in this segment as there are no additional point sources discharging to the river in this segment. Most of the pollution problems in this segment are carried out from the previous segment. Additional non-point sources include failing septic systems in Medfield. The segment is designated Water Quality Limited with a present water quality classification of Cl and a future goal of Class Bl.

The Charles continues northward for two miles to its confluence with Sugar Brook. Present water quality in this segment is Class Cl. Stop River which receives the discharges from the Pondville State Hospital, Wrentham State School, and the Norfolk and Walpole Massachusetts Correctional Institutions, is the largest source of pollution in this segment. Stop River itself is divided into three segments which range from Bl to U in quality. The river is of Cl quality at its confluence with the Charles. Other sources in this segment include high organic and nutrient loads leaching from surrounding and tributary wetlands and failing septic systems in Medfield. Vine Brook, which drains a portion of West Medfield, joins the Charles just downstream from the Stop River. The water quality goal for this segment is Class Bl. The water quality goal for the Stop River is Class B. The Stop River has been designated Anti-degradation while the main stem Charles segment has been designated Water Quality Limited.

Sugar Brook is the next tributary to the Charles. Sugar Brook is the third of the three most severely polluted segments in the Charles Basin and is in fact the worst of those three. Both the National Can Corporation and Cott Corporation discharge wastewater to the brook as well as the Millis wastewater treatment plant. The brook is anoxic (anaerobic) and suffers from toxic ammonia levels, extremely high phosphorous, and bacteria levels, extremely low pH (highly acidic), sludge deposits and foul odors. The Millis sanitary landfill is also located in the brook's watershed. Sugar Brook lies completely within Millis and has a total drainage area less than one square mile. The stream has been designated Water Quality Limited with an existing condition of U quality water and a goal for Class B water quality.

From Sugar Brook, the Charles continues northward through the towns of Medfield, Millis, Sherborn and Dover. Mill Brook, Bogastow Brook, and Sewall Brook all join the Charles over the five mile course which extends to Bridge Street in Dover. Present water quality in this segment is Class C1 with a goal of Class B1. This segment is Water Quality Limited. Sewall Brook lies completely within Sherborn. Mill Brook drains portions of Dover and Medfield. Bogastow Brook drains portions of Holliston, Sherborn, Medway and Millis and is the largest tributary to the Charles with a drainage area of 25.5 square miles. Subsurface disposal systems in Holliston and the discharge from the Lane (Ty-Car) Manufacturing Company are possible pollution sources to Bogastow Brook. However, as of August 1977, Lane (Ty-Car) is in compliance with the NPDES permit implementation schedule to correct pollution problems. Pollution sources to this segment of the Charles include Sugar Brook, Bogastow Brook, the Medfield State Hospital treatment facility, and the Medfield wastewater treatment plant.

The Charles continues its northward flow for another three and one half miles to the South Natick Dam. Over this segment, the river slowly begins to recover as dissolved oxygen levels rise. No point sources discharge to this segment. Two small tributaries join the Charles in this segment. Indian Brook drains portions of Sherborn and Natick. Davis Brook drains a small portion of Natick. The segment is Water Quality Limited, presently meeting Class C1 standards with a water quality goal of Class B water.

Shortly downstream from the South Natick Dam the river makes a quick U-turn before it continues northward again. A distance of three miles downstream from the dam, the river turns south and is joined by the outflow of Waban Brook and Fuller Brook. Waban Brook drains a fairly large area which includes portions of Weston, Wayland, Natick and Wellesely. The brook's drainage area includes the drainage areas of both Morses Pond and Lake Waban. Fuller Brook, draining portions of Needham and Wellesley, reaches its confluence with Waban Brook just prior to their combined confluence with the Charles.

The Charles runs south for another three miles and abruptly turns east forming the border between Needham and Dover, Needham and Westwood and Needham and Dedham. The river is joined by four tributaries over this six to seven mile stretch. They are Trout Brook, draining a portion of Dover, Noanet Brook, which lies completely in Dover, Powissett Brook, draining portions of Westwood and Dover, and Rock Meadow Brook, which lies wholly within Westwood. Also, located in the middle of this reach is the Cochrane Dam at Charles River Village, in Needham and Dover.

After it passes under Route 128, the Charles turns south again through Dedham. As it flows through Dedham Center it swings north again. At that point, up to one third of the flow in the Charles is diverted to the Neponset River via Mother Brook.

For a short distance, the Charles serves as the border between Boston and Dedham. Sawmill Brook, draining portions of Brookline, Newton and Boston, joins the river at this point. The City of Boston landfill is located at the confluence of the brook and the river.

The river flows on northward through the urbanized areas of Boston, Newton, Needham and Wellesley being joined by South Meadow Brook (Newton), Hurd Brook (Needham-Wellesley), and Rosemary Brook (Needham-Wellesley). Below Newton Lower Falls, the Charles is crossed by a mish-mash of highways including Routes 128, 30, 16 and the Mass. Turnpike. In the midst of all this activity, Seaverns Brook in Weston joins the Charles. Seaverns Brook drains both the Weston Reservoir and Norumbega Reservoir. Further downstream the Charles is met by Stony Brook, which drains portions of Lincoln, Lexington, Waltham and Weston. Water from Hobbs Brook (Cambridge) Reservoir and the Stony Brook Reservoir is diverted from the Stony Brook Reservoir for use by the City of Cambridge.

The Charles gradually turns east toward its confluence with Boston Harbor as it passes between Waltham, Newton and Watertown. Beaver Brook, draining portions of Lexington, Arlington and Waltham, discharges to the river in this stretch. Cheesecake Brook draining a portion of Newton is the last tributary to the Charles before it cascades over the Watertown Dam to become the Charles Basin.

Over the length of the 32 mile segment just described, from the South Natick Dam to the Watertown Dam, water quality has improved slightly from Class C1 to Class C. Although there are no major point sources to this segment, carry-over effects and urban non-point sources prohibit the Charles from meeting its Class B water quality goal. Sources include occasional overflows/bypasses from Waltham and other Middle Charles communities, urban runoff, landfills in Newton and Waltham, and failing septic systems in portions of Weston, Wellesley and Natick. The river is also subject to numerous "accidental" or occasional pollution problems such as oil spills, gasoline spills, litter and debris. The entire segment has been designated Water Quality Limited.

The segment of the Charles from the Watertown Dam to the Charles River Dam at the river's confluence with Boston Harbor is known as the Charles Basin. The dam, which serves as the foundation for the Museum of Science, was constructed in 1910 to flood odorous and unsightly mud flats and in so doing turn the Charles Basin into a recreational fresh water lake. Since then, the dam has created more problems than it was intended to solve. Due to the operating practices of the lock, a tremendous quantity of salt water has infiltrated the basin forming a salt water wedge along the bottom of the basin, which at points comes nearly to the surface. The water in the basin is stratified in several dimensions. Pollutants entering the basin become trapped in the anoxic zone created by the salt wedge and in the sediments. Pollution enters from a variety of sources. Sewer bypasses and overflows, combined sewers, stormdrains, cooling water discharges, vessel discharges and litter of all sorts find their way into the basin. Specific pollutants include extremely low dissolved oxygen in the fresh water (surface) zone and virtually no DO in the salt water (subsurface) zone. High levels of hydrogen sulfide, bacteria, biochemical oxygen demand, nutrients and solids are found throughout the basin. Researchers from MIT in a 1972 study indicated the presence of several exotic lipophilic organic compounds including alkyl napthalenes, alkyl anthracenes, dibutyl phthalate, and pyrene. Sediment samples taken by DWPC in 1973 revealed high levels of eight heavy metals; mercury, cadmium, lead, zinc, nickel, copper, chromium and arsenic.

In spite of the mistreatment inflicted upon the river and the Charles Basin by mankind, the river continues to provide some of the best water based recreation in the metropolitan area. Fishing is good to excellent in the upper and middle Charles. Canoeing is also quite popular. The river abounds with a variety of scenery and is a nature lover's paradise. The Charles Basin is in great demand for boating enthusiasts and is the training ground for some of the finest college crew teams in the nation and the world. Its banks serve as jogging, walking and bicycling areas for large numbers of Boston and Cambridge residents. Each year thousands of people throng the Esplanade for concerts at the Hatch Memorial Shell and to watch the Fourth of July fireworks extravaganza.

This report is intended to provide the basis for the development of a comprehensive approach to the water quality and waste treatment management of the Charles River. The goal of this program is to return the Charles to a water quality condition befitting its magnificence as a river.

In the Lower Charles, the present condition is due to municipal and industrial discharges and non-point sources. To upgrade the present quality to B, advanced wastewater treatment, abatement of stormwater overflows and "best management practices" would be needed. Middle and Lower Charles suffer predominantly from urban runoff and combined sewer overflows. If these sources are abated and salt water intrusion is effectively reduced, water quality may be upgraded to B.

Chapter 3

Existing and Potential Sources of Water Pollution

CHAPTER 3 EXISTING AND POTENTIAL SOURCES OF WATER POLLUTION

In this chapter, you will find:

A. A definition of point and non-point pollution sources;

B. A description of the existing point sources of pollution in the Lower Charles River Basin;

C. A description of the existing non-point sources of pollution in the Lower Charles River Basin;

D. A description of the potential point and non-point sources of pollution in the Lower Charles River Basin;

E. Community Profile: a summary of point and non-point pollution problems, existing and potential, by community.

A. POINT AND NON-POINT POLLUTION SOURCES

The purpose of this chapter is to describe existing water pollution sources, which pose serious threats to overall basin water quality. Of equal importance is the identification of potential sources and resultant problems which are expected to occur if rapid growth continues in its present pattern. This information will assist communities in the prevention of pollution which could result in costly clean up programs in the future.

Two general categories of water pollution are discussed in this chapter. One category is comprised of those sources of pollution which emanate from a particular location or point. They are known, therefore, as point sources and include industrial discharges, municipal treatment plants and discharges from storm drainage systems. Another category, non-point sources, are diffuse sources of pollution which do not have a single point of discharge, but rather, generate from an extensive land area. Stormwater runoff, erosion, failing septic systems and leachate from landfills are typical non-point sources. Although non-point sources have only recently been recognized as pollution problems, their impact is substantial. Particularly is suburban areas, non-point sources comprise a large proportion of the total pollutant loadings of streams and waterbodies. The remainder of this chapter describes the existing and potential point and non-point sources of water pollution in the basin, first in general, descriptive terms followed by a listing of sources by community.

B. EXISTING POINT SOURCE POLLUTION PROBLEMS

The best known sources of pollution are point sources, especially the discharges from wastewater treatment plants, combined sewer systems and industrial activities. In the Lower Charles River Basin, the effect of combined sewer systems and industrial discharges is of primary interest. The Charles Basin, its tributaries and Boston Harbor are polluted by these sources. Municipal sewage contributes to the pollution of Boston Harbor from the MDC's inadequate primary treatment plants at Deer and Nut Island. The harbor problem will be covered in MAPC's 208 Areawide Plan.

Municipal Sewerage Facilities - Twelve of the fourteen communities covered in this report have extensive sewage collection systems. These systems serve about 95 percent of the basin's present population. Three of the sewered communities are served, at least in part, by combined sewers. All dry-weather wastewater flows are discharged to the MDC for treatment at the Deer or Nut Island treatment plants. The treatment facilities at Deer and Nut Island provide primary treatment and discharge chlorinated effluent to Boston Harbor. During wet weather, flows in excess of the sewer system's capacities overflow to local waters from communities with combined sewers or emergency relief-facilities. These overflows are the only municipal sewage discharges to the Lower Charles River Basin.

The towns of Belmont, Lexington and Watertown and the city of Waltham have separate sewer systems tributary to the Deer Island facility. The towns of Dedham, Natick, Needham and Wellesley have separate sewer systems that are tributary to the Nut Island facility. Newton has a separate sewer system, but is served by both treatment facilities. The town of Brookline has some combined sewers and is served by both treatment facilities. The city of Cambridge has combined sewers and is served by the Deer Island facility. Boston has combined sewers and is served by the Deer and Nut Island facilities.

The towns of Lincoln and Weston have no sewers, but Weston operates a small, secondary treatment plant for the wastewater from the junior high school and the bus garage.

Non-Municipal Sewerage Facilities - Two non-municipal sewage treatment plants are located in the basin. In Lincoln, the Lincoln Woods Cooperative Homes has a secondary treatment facility that employs infiltration beds for final effluent disposal. Regis College in Weston operates a small primary treatment facility. Effluent is discharged to sand beds for ground disposal. This discharge may be a potential threat to the ground water quality in the Weston Reservoir area.

Overflows - Four communities have overflows from their sewerage systems to local water in the Lower Charles River Basin. These overflows have been identified as significant pollution sources and their abatement is now in progress.

The town of Belmont has emergency overflow facilities at a pumping station in case of power outages. The overflow has reportedly never been activated.

The city of Boston has about 120 overflows from its separate and combined sewer systems. Twenty-nine of these overflows discharge to the Charles River and its tributaries.

The city of Cambridge has combined sewers. The city's NPDES permit identifies 15 overflows to the Charles River. Seven of these have been eliminated by construction of the MSD North Charles relief sewer and the separation of combined sewers.

The city of Waltham has two inverted siphons that have overflow potential during extreme wet weather. The overflows reportedly occur after several days of heavy rain. Plans have been made to eliminate these overflows.

In addition, the city of Somerville (covered in the Mystic River Basin Report) has two overflows, one to the Charles River and one to the Millers River. These overflows will be eliminated upon completion of the Charles River marginal conduit project.

Sludge - Directly related to the issues of sewer systems and treatment plants is the problem of sludge. Sludge consists of the solids removed from wastewater in the treatment process. As treatment plants become more effective, as required by federal law, and sewer service is extended, the volume of sludge will increase significantly.

The wastewater from the MSD-member communities is treated at the MSD's Deer and Nut Island treatment plants. The resulting sludge is digested, chlorinated and discharged to Boston Harbor on the outgoing tide. This method of sludge disposal is unsatisfactory and contributes significantly to the poor water quality of the harbor. The MDC and its consultants are developing alternatives as part of the Boston Harbor-Eastern Massachusetts Metropolitan Area (EMMA) study. The issues of Deer Island, Nut Island and Boston Harbor will be considered in the 208 Areawide Plan.

There is also one small municipal and two private wastewater treatment facilities in the basin. These facilities serve the Weston Junior High School, Regis College and the Lincoln Woods Cooperative Homes. Sludge from the Weston Junior High School is pumped from the underground holding tank by a septage pumper and hauled for disposal. The sludge from the Regis College treatment facility is dewatered on sand beds and hauled to the Weston landfill. The Lincoln Woods Cooperative Homes treatment facility employs aerobic digestion. The digested sludge is pumped out and disposed of in the MSD system.

For additional background and detail on the wastewater treatment, sludge handling, and overflow problems in the Lower Charles River Basin, please refer to "Charles Basin Inventory and Evaluation of Public Wastewater and Stormwater Facilities" and "Boston Harbor, Mystic, and Neponset Basins Inventory and Evaluation of Public Wastewater and Stormwater Facilities" - Camp, Dresser & McKee, 1977, reports prepared for the MAPC 208 project.

Metropolitan Sewerage District: Wastewater - The Metropolitan Sewerage District (MSD) provides wastewater collection and treatment facilities for 43 towns and cities. The wastewater is collected and transported by the MSD interceptor system to one of two sewage treatment plants. These plants provide primary treatment and are capable of treating a combined average daily flow of 450 million gallons and a maximum daily flow of 1.2 billion gallons. The effluent is discharged to Boston Harbor and contributes to the water quality degradation of the harbor.

Deer Island Treatment Plant - This facility was designed to provide primary treatment to an average flow of 343 mgd and a peak flow of 848 mgd. Pretreated wastewater enters the facility from the Main Pumping Station and the Winthrop Terminal facility. The Main Pumping Station receives pretreated wastewater from the Ward St. and Columbus Park Headworks via the Boston Main Drainage tunnel, and from the Chelsea Creek Headworks via the North Metropolitan Relief tunnel. The pumping station was designed to pump an average flow of 319 mgd (peak = 788 mgd) to the treatment plant. The Winthrop Terminal facility receives raw wastewater from the North Metropolitan Sewer and provides pretreatment before discharging the wastewater to the treatment plant. The Winthrop facility was designed to handle an average flow of 24 mgd (peak = 60 mgd). Pretreatment at all the headworks and the Winthrop facility consists of screening and grit removal.

The Deer Island treatment plant presently treats an average flow of about 292 mgd. The treatment process consists of preaeration, sedimentation and chlorination. The effluent is pumped to the outfall system and discharged to Boston Harbor. Two outfalls are normally used, but there can be five outfalls (including relief) in operation during extreme conditions. A relief bypass is available from the Winthrop Terminal facility to the outfall system for flows greater than 60 mgd.

Solids from the sedimentation basin are thickened and anaerobically digested. Lime is added to the thickeners to aid thickening and digestion. The sludge from the digestors is mixed with the chlorinated primary effluent and discharged to Boston Harbor with the outgoing tide. A by-product of the sludge digestion process is a gas that is used to generate the electrical power for the facility.

Nut Island Treatment Plant - This facility was designed to provide primary treatment to an average flow of 112 mgd and a peak flow of 300 mgd. Raw wastewater enters the facility from the High Level sewer and flows through the preliminary treatment facilities. The preliminary treatment consists of screening, grit removal and comminuation. Screenings and grit are pneumatically transported to a multiple-hearth incinerator. The pretreated wastewater is pumped to pre-aeration tanks and then flows by gravity through the sedimentation basins and the outfall system. Chlorine is applied to the influent before screening and to the effluent following primary sedimentation. The outfall system consists of two long outfalls that discharge to the Outer Harbor. A shorter outfall is available for extreme tides or influent flows. An overflow outfall on the eastern shoreline is also available for extreme conditions. The facility is currently overloaded hydraulically as the average flow to the plant is about 139 mgd.

Solids from the sedimentation basins are pumped directly to the anaerobic digesters. Following digestion, the sludge is mixed with the chlorinated primary effluent and pumped across Boston Harbor to the northern tip of Long Island. From there it is discharged to the President Roads on the outgoing tide. The gas from the anaerobic digestion process permits the Nut Island facility to be energy self-sufficient.

Metropolitan Sewerage District: Combined Overflows - The MSD has recognized that one of the most serious pollution problems in the Charles River Basin (and Boston Harbor, the Neponset and Mystic Basins) is the wastewater overflow from combined sewer systems. In order to reduce the effect of the combined sewer overflows on the Charles River, the MDC has constructed and is constructing facilities to intercept and treat the overflows. These facilities are briefly described below.

Cottage Farm Detention and Chlorination Station - This facility, located in Cambridge just upstream from the Boston University Bridge, was constructed in 1971 to provide temporary storage and treatment for the combined sewer overflows to the Charles Basin from Boston, Brookline and Cambridge. The wastewater enters the facility from relief sewers on both banks of the Basin. The North Charles relief sewer intercepts the overflows from the North Charles Metro Sewer to the Basin in Cambridge. It also collects some of the combined sewer overflows from Cambridge. The South Charles relief sewer provides overflow relief for the Charles River Valley sewer. This is on the south bank of the river. This relief sewer also receives substantial combined wastewater and surface drainage from the Muddy River, Salt Creek and Faneuil Brook areas in Boston and Brookline. (Many overflows still reach the Basin when the capacity of the relief facilities is exceeded. When the sewer separation and improvement projects in these communities are completed, the frequency of these overflows should decline.)

The detention and chlorination facility is capable of storing 1.5 million gallons of wastewater before an overflow to the Basin is necessary. The stored wastewater can be discharged back to the interceptor system for treatment at Deer Island. Flows exceeding 1.5 million gallons are treated and discharged to the Charles Basin. Treatment consists of screening, skimming, chlorination and sedimentation. This facility has a capacity of 233 mgd.

Charles River Marginal Conduit Project - This facility, located upstream of the new Charles River Dam, is designed to provide treatment for the combined sewer overflows from the Boston sewer system, the MDC Boston and Cambridge marginal conduits and other various overflows. The Boston marginal conduit provides relief for the West Side interceptor and receives combined wastewater and surface drainage from the Stony Brook conduit system. There are several overflows from the Boston marginal conduit to the Basin. The Cambridge marginal conduit intercepts the combined wastewater from the area north of Binney and Commercial Streets in Cambridge. At the present time, these conduits discharge to the Inner Harbor.

The detention and chlorination station will be capable of treating flows up to 323 mgd. Treatment will consist of screening, skimming, sedimentation and chlorination. The effluent will be discharged to Boston Inner Harbor.

Industrial Discharges - Pollution from industrial sources is often thought to be one of the major wastewater treatment problems in urban communities. In the Lower Charles Basin, every community except two have extensive sewer systems that serve both residential and industrial customers. The wastewater is discharged to the MSD system, treated at the Deer Island or Nut Island treatment facility and discharged to Boston Harbor. As a result, most of the industrial wastewater is conveyed out of the basin and does not affect the local water quality. This industrial wastewater, however, is a significant contributor to the larger problem of inadequate municipal wastewater treatment. There are industries that still discharge wastewater to local surface waters. These discharges are now subject to state and federal discharge regulations.

To regulate the discharge of industrial wastes, the National Pollutant Discharge Elimination System (NPDES) was established under Public Law 92-500. In Massachusetts, the EPA issues

NPDES discharge permits to industries (and municipal facilities) that release wastewater to surface waters. The permit contains a description of the discharge, effluent limitations, and an implementation schedule consistent with the goals of PL 92-500. The permit may require the industry to develop and implement a scheduled program to provide treatment facilities before discharging to a surface water. Pretreatment may be required if the discharge is to a municipal sewer system.

There are thirty-nine industrial wastewater sources in the Lower Charles Basin communities that have been issued NPDES discharge permits. Thirteen of these originate from the Lower Charles Basin communities but affect the water quality in other river basins. Therefore, these are covered in more detail in their respective basin reports. In addition, there are eleven industries permitted to discharge to Boston Harbor. These discharges are described in the community profiles. The permitted industries are listed below with their respective receiving waters.

Belmont Springs Water Co., Belmont	storm drain to Charles River
Amstar Corp., Boston	Mystic River
Barnstead Co., Boston	Charles River
Distrigas of Massachusetts Corp., Boston	Mystic River Channel
Great Atlantic and Pacific Tea Co. Boston	Boston Harbor
Hottop Pavements, Inc., Boston	Neponset River
Mass. Port Authority-Logan Int'l Airport, Boston	Boston Inner Harbor
MBTA-Lincoln Power Station, Boston	Boston Harbor
New England Aquarium, Boston	Boston Harbor
Schrafft Candy Co., Boston	Mystic River
Thompson Academy, Boston	Boston Harbor
Westinghouse Electric, Boston	Neponset River
White Fuel Corp., Boston	Boston Harbor
Cambridge Electric - Blackstone St. Station, Cambridge	Charles River Basin
Cambridge Electric - Kendall Square Station, Cambridge	Charles River Basin
Dewey & Almy Chemical Co., Cambridge	Fresh Pond Brook
M.I.T., Cambridge	Charles River (Basin)
Boston Edison - Mystic Station, Charlestown	Mystic River
Boston Sand & Gravel, Charlestown	Mystic River
Revere Sugar Refinery, Charlestown	Mystic River
U.S. Gypsum Co., Charleston	Mystic River
Bethlehem Steel Copr., East Boston	Boston Harbor
Amerada Hess Oil & Chemical Corp., East Boston	Chelsea River
Mobil Oil Corp., East Boston	Chelsea River
Magnesium Casting Co., Hyde Park	Neponset River
U.S. Army Natick Laboratories, Natick	Lake Cochituate
Community Service Stations, Inc., Newton	brook to Charles River
St. Regis Paper Co., Newton	Charles River
White Fuel Corp., W. Newton	Charles River
Boston Edison - L. St./New Boston Station, South Boston	Boston Harbor

The Gillette Co., South Boston	Boston Harbor
MBTA - South Boston Station, South Boston	Boston Harbor
Seaboard Enterprises, Inc., South Boston	Rescue Channel
Exxon Co., Waltham	Stony Brook
Shell Oil Co., Waltham	Beaver Brook
Barry Div. Barry Wright Corp., Watertown	Charles River
Haarts-Mason, Inc., Watertown	Charles River
Quincy Market Cold Storage, Watertown	Charles River
Massachusetts Broken Stone Co., Weston	Stony Brook

Twenty-four of the above industries have been issued permits to discharge cooling water. Fourteen of these discharges consist of uncontaminated cooling water. The remaining ten discharges have some type of contaminant and treatment may be required. Nine other industries have NPDES permits that require the control of stormwater runoff from the respective properties. Treatment consisting of oil/water separators is required. In addition, there are five industries that discharge process wastewater and one private sewage treatment facility that have been issued NPDES permits.

There are many other industries in the Lower Charles Basin that have not been issued NPDES permits. Some of these industries discharge their wastewater to a municipal sewerage system and, as a result, do not require an NPDES permit. However, just because an industry discharges its wastewater to a municipal system doesn't mean that the industrial wastewater has no effect on the treatment facility or receiving waters. Industrial wastewater containing metals, grease or high organic loads can upset the treatment processes and cause inadequately treated wastes to be discharged to the receiving waters. Large discharges of solids to a municipal system can cause surcharging if the solids are allowed to accumulate in the sewers. Each community or sewer district is required to prepare a sewer use ordinance that identifies and limits the types of waste that will be accepted at the treatment works. The ordinance may also require that industries provide pretreatment for their wastewater before discharging to the municipal system.

Another category of industrial wastewater discharge that does not require a permit is a discharge to the ground. Many industries located in towns without sewers utilize sand infiltration beds to dispose of their treated wastewater. This can result in the pollution of the groundwater, and, potentially, the degradation of nearby surface waters. The local board of health is responsible for regulating all wastewater discharges of less than 15,000 gpd to the groundwater. Wastewater discharges greater than 15,000 gpd are the responsibility of the Mass. Bureau of Environmental Control.

All of the industrial discharges in the Lower Charles Basin have been identified and evaluated in "Report to the Metropolitan Area Planning Council on 208 Areawide Industrial Discharge Project", prepared by Metcalf & Eddy, Engineers (available at the 208 Water Quality Project office).

Stormwater/Drainage Systems - Storm sewers are usually installed to channel stormwater runoff away from structures and dwellings and off streets and highways. These runoff collectors serve to protect public health and safety by minimizing danger from floods and diseases carried by polluted water.

Stormwater runoff is a problem of increasing severity as it is essentially related to the process of urbanization. Urban growth and development bring about changes in the natural water cycle by increasing the area of impervious surface and thereby increasing the rate of runoff. Pollution from runoff occurs when precipitation flushes an urban or suburban area and carries pollutants to receiving waters. As the surface is flushed, polluted water flows overland to collection systems or directly to nearby surface water.

Stormwater runoff may contain substantial amounts of organic material, inorganic solids, nutrients, heavy metals and microorganisms which can have a significant impact on receiving water quality.

The total annual pollutant load in stormwater can be greater than the annual pollutant load discharged from municipal waste treatment facilities during dry weather. This fact could preclude meeting water quality goals regardless of the degrees or types of treatment provided for dry weather wastewater flows.

At the present time, there is insufficient data on stormwater discharges and receiving water quality during wet weather periods upon which to determine the actual contribution of the stormwater pollution to the total pollution load affecting streams. Under these conditions, 208 staff developed a three stage approach to analyzing urban runoff in the 208 area.

As the first stage in the stormwater analysis, consultant Camp, Dresser & McKee was employed to inventory data on existing municipal stormwater collection systems. This data serves two purposes. First, the information should serve to direct communities as to where control practices should be applied and which practices are likely to be most effective. Secondly, it will serve to focus wet weather data collection and analysis activities on particularly significant systems. Stormwater collection systems identified by CDM are listed by town in Tables E-1 through E-4 in Appendix E.

The second stage of the stormwater analysis was to quantify the water quality impacts of collection systems identified in the CDM inventory in order to identify significant systems. A number of stormwater models were evaluated to accomplish this task. The model used is a hybrid of several simplified desktop analysis techniques developed by 208 engineering staff. There are five components to the model used. They include the following:

1. Land Use - Existing and future land use determined from the DeFacto Land Use Pattern in order to calculate the coefficient of runoff, Cv. The methodology used to derive Cv was taken from EPA's Areawide Assessment Procedures Manual for Urban Area.

2. Hydrologic Parameters - Rainfall statistics including Annual Mean Rainfall, number of storms per year, number of days of rain per year, mean depth of rain per event and average storm duration were collected from the National Oceanic and Atmospheric Administration's Environmental Data Center and used to determine the Design Storm, DS (in inches); the Design Storm Volume, DVSS (in million gallons, MG); and the Design Storm Duration, DSD (in days) using the statistical methods used in EPA's 1976 Needs Survey - Summaries of Technical Data for Combined Sewer Overflows and Stormwater Discharges.

3. Pollutant Loads - Pollution loads from stormwater discharges were developed for Biochemical Oxygen Demand (BOD) and Suspended Solids (SS) using equations found in the EPA 1976 Needs Survey methodology.

4. Receiving Water Quality Impacts - Required Treatment Levels - A methodology was presented in the 1976 Needs Survey document which allows the user to determine the treatment levels required in order to meet receiving water quality standards. Although this methodology is available for use in the MAPC model, it was not used in this study due to serious data deficiencies which included lack of in-stream flow and water quality data and of in-stream reaeration rate, K_2, data. Lack of this data and any other means to relate runoff loads to instream water quality seriously constrains the utility of the model's output. Until the missing data is supplied or another methodology is developed which will make that critical connection, decisions to apply structural, capital intensive control measures to stormwater systems cannot be environmentally or economically justified.

5. Costs of Alternative Structural Controls - Capital and Operation and Maintenance Costs for five alternative structural controls plus disinfection were calculated using the 1976 Needs Survey cost algorithms. Alternatives include Screening - Swirl Concentration, Sedimentation, Air Floatation with chemicals, Flocculation-Sedimentation, and Filtration. Disinfection costs were calculated separately and can be added to the costs of the five alternatives as needed.

Tables E-15 through E-18 (in Appendix E) summarize input and output data generated by this modeling approach. The modeling results serve two purposes. First, it serves to identify particularly significant discharges based on discharge strength. Second, it provides first-cut, order-of-magnitude estimates of the cost for structural control alternatives. A more detailed description of the model will be prepared by January, 1978. It is felt that an analysis tool of this kind will be of valuable assistance to local officials, developers, planners and conservationists.

The third stage of the program involved the development and operation of a storm drain sampling program to collect and analyze samples of stormwater runoff to determine stormwater loadings under actual field conditions during a rainfall event. Virtually all the stormwater discharges identified by CDM in the Mystic Basin were field inspected to evaluate access, outfall conditions and amenability to sampling in addition to close to one hundred additional outfalls located in the Lower Charles and Neponset Rivers. The results of those field surveys led to the selection of five sampling stations in the Mystic Basin. Each of these stations was sampled during 3 to 5 rainstorms between September 1, 1977 and November 1, 1977. The results of this effort have not yet been received from the laboratory. They will be the subject of a separate report due to be produced in December 1977. This data will be useful in determining land use - water quality relationships, event-specific loadings and time variance, and in developing loading functions for use in runoff and water quality models.

C. EXISTING NON-POINT SOURCE POLLUTION PROBLEMS

As point source pollution problems are gradually reduced through upgrading of publicly-owned treatment facilities and enforcement of NPDES permit conditions, it is possible that severe non-point source problems could still keep the Lower Charles River Basin from achieving its water quality goals. Non-point sources of pollution that presently exist in the Lower Charles Basin include failing septic systems, improperly sited and operated landfills, poor storage and excessive applications of road salt, and stormwater runoff which carries pollutants from streets to waterbodies.

As you read about existing non-point source pollution problems in the Lower Charles Basin, you will notice that most of them resulted from inadequate planning and growth management in the past. Most of the problems could have been avoided for less cost than the cost of correction. This fact is especially important to those basin communities which are expected to grow rapidly in the near future. Unless the following problems are properly understood and effectively managed, the overall impact of these non-point sources will become more serious as the communities in the basin continue to grow.

Failing Septic Systems - The septic tank is a safe and adequate means of sewage treatment if the tank and drainage field are properly constructed in appropriate soils and provided sufficient maintenance. However, in practice a septic tank is typically so overloaded with sewage that materials simply pour in one side and out the other. If the soil is insufficiently porous, the raw effluent rises to the toil surface and flows into the nearest waterbody.

At present only 5 percent of the residents of the Lower Charles River Basin rely on septic systems (or cesspools) for wastewater treatment and disposal. A large number of these on-lot systems exist in two communities of this basin namely Lincoln and Weston. The rest of the communities are 80 percent or more sewered. And in Natick and Weston, areas of failing systems have been identified by local officials, MAPC staff or by Camp, Dresser & McKee (CDM), the project's engineering consultants.

Failure to attain a desirable level of treatment may occur due to many reasons more common among which are: improper siting, overloading, no pumping out or rarely pumping out the tank, clogging of drainage field and less commonly structural and chemical failures. Structural failure may happen due to the cracking of the unit or its components thereby causing leakage of the untreated wastewater. However, this type of failure is not easy to detect. Chemical failure takes place when a group of disposal units together may surcharge an adjacent waterbody with undesirable chemical compounds.

Chemical failure is rarely cited because it requires sophisticated analysis and data not typically available at the town level.

Surface discharge or "bubbling-up" failure is more commonly cited by town officials and may be documented by town septic tank repair records, information from local septage haulers or by the frequency of complaints to public health officers.

The causes of septic systems problems in the Lower Charles River Basin are varied. They include improper siting, testing or installation, infrequent maintenance, overloading or allowing systems at too high a density for soil or other conditions. Most of these causes are related to the communities' past decisions to permit development with on-lot sy stems on land which did not have the capability to handle it without environmental damage.

(For more on septic system problems, see the Community Profiles in this chapter.)

Septage - Septage disposal is not among the major issues in the Lower Charles River Basin communities. All communities except Lincoln and Weston are mostly sewered and are members of the Metropolitan Sewerage District. Septage is disposed of by licensed haulers into the MSD system. Lincoln and Weston being non-MSD members dispose of their septage into the MSD sewers under contract. The MSD will accept septage from non-member communities until December, 1979; after this date, affected communities must implement alternate disposal practices.

Failing septic systems can cause water quality problems and can thus threaten public health. Such systems require frequent pumping, sometimes on a monthly or even weekly basis. Even those septic systems which operate properly require periodic pumping - at a recommended interval of every two to three years. Based on existing population served by septic systems in each community, the following estimated quantities of septage would be generated in the Lower Charles River Basin.

Total Septage Volume Generated

	Gallons/year	Gallons/day
Belmont	220,000	600
Boston	0	0
Brookline	0	0
Cambridge	0	0
Dedham	400,000	1,100
Lexington	1,350,000	3,700
Lincoln	620,000	1,700
Natick	876,000	2,400
Needham	660,000	1,800
Newton	2,700,000	7,500
Waltham	430,000	1,200
Watertown	0	0
Wellesley	360,000	1,000
Weston	1,400,000	3,800
	9,016,000	24,800

Communities with areas of septic system failures requiring frequent pumping, will generate greater septage volumes than those shown here. Communities which choose to continue development on septic systems or to improve septic system maintenance as a means of limiting sewering, will have to make plans to deal with increased volumes of septage.

(For more on septage disposal problems, see Community Profiles in this chapter.)

Road De-icing Salt - Both improper storage and generous application of de-icing salt on highways have been recently identified as the major cause of rising sodium and chloride levels in public water supplies throughout the state. Rising chloride levels in surface reservoirs parallel rising annual consumption of salt by the Massachusetts Department of Public Works (MDPW) and local highway departments. Many public wells tapping aquifers beneath the surface of the ground show similar trends. Drinking water for the Lower Charles River Basin communities is considered to be of high quality. Unfortunately, public drinking water in most urbanized areas has been degraded, primarily by runoff draining from highways during winter and early spring. Salty water moves along stream channels into surface reservoirs and some infiltrates to recharge groundwater aquifers. Because water moves far more slowly through an underground aquifer than along a river channel, aquifers do not recover from periodic contamination as quickly as surface reservoirs. Severely polluted groundwater may not be discovered for months or years after contaminants entered the aquifer. Similar time may be required before natural flushing action again reduced the concentration of the pollutant to acceptable levels.

The primary component of crystalline road salt is sodium chloride. In water, salt molecules (NaCl) break apart and form separate sodium and chloride ions. The acceptability of water for human ingestion, and many commercial and industrial uses has historically been judged according to chloride ion concentration. For public drinking water the U.S. Public Health Service (1962) recommended a limit for chloride of 250 mg/l. Ocean water contains about 20,000 mg/l chloride and 10,000 mg/l sodium. The drinking water limit is a widely used aesthetic standard in which the primary consideration is taste. Above this threshold value many consumers will reject water due to its unpleasant taste, although there is not necessarily a health hazard for the average user. Because the acceptable chloride level varies greatly with intended use, water that is acceptable for human ingestion may be intolerable for many commercial, agricultural and industrial uses that require far lower concentrations to function satisfactorily. Neither the sodium nor chloride ion can be easily removed by methods commonly used in treating drinking water for public consumption.

Sodium levels have recently taken on greater significance in the assessment of drinking water quality due to the relationship of sodium to numerous human medical problems. Medical authorities advise that patients with congestive heart failure, hypertension, or kidney and liver disease should use water containing no more than 20 mg/l sodium. The necessity to restrict sodium intake for patients is well documented and not in dispute. However, some medical evidence also suggests that a large part of the population is also affected by similar but undiagnosed health problems, either aggravated or caused by excessive sodium.

In 1970 the State Commissioner of Public Health notified 63 communities that their drinking water supplies contained sodium in excess of 20 mg/l and ordered that appropriate local authorities be approased of this fact. At that time no Federal or State standard for sodium in drinking water had been defined. In 1977 revised standards for public drinking water will be promulgated for the Commonwealth by the Department of Environmental Quality Engineering. Maximum permissable sodium concentration will probably be set at 20 mg/l, with a provision that suppliers of water that cannot meet this requirement notify all consumers in writing that the sodium warning level is being exceeded. The chloride standard will remain at 250 mg/l.

Since the Commissioner's notification in 1970, many Massachusetts communities, including those within the Lower Charles Basin, have reduced their use of salt for road de-icing purposes. The town of Weston was particularly hard hit when in 1970, the town lost it's wells due to salt contamination and was forced to tie into the Metropolitan District Commission.

Intelligent use of road salt first requires careful protection of the storage area from precipitation. In-stream sampling performed by the MAPC's Water Quality Project indicates that severe contamination of streams is inevitable wherever piles of salt or sand salt mixture remain uncovered. Open salt piles located on highly permeable soils in aquifer recharge areas pose serious threats to subsurface water quality.

Covering piles with plastic sheet or canvas tarpaulin does not provide reliable protection. Local officials report that canvas tarps are expensive and both types of covers are subject to wind damage, theft, and vandalism. Although infiltration of water can be minimized by installing impermeable bituminous pads on which to store salt, wooden storage sheds appear to be the most reliable method of protecting salt piles from runoff caused by precipitation.

It is difficult, if not impossible to control the runoff of salty water after salt has been applied to roads. Although natural dilution aids in reducing the concentrations of sodium and chloride, total reliance of dilution processes for protection of water resources is insufficient. Minimizing stream and aquifer contamination caused by runoff from salted highways requires coordinated effort by local and state highway departments, public health officials, and environmental groups. Strong, reasonable controls on salt application are necessary at the local level. Initial efforts should concentrate on the following:

- Development of maps showing local drainage basins and road networks with locations of salt-sensitive targets (aquifers, wells, streams tributary to reservoirs).

- Development of a selective application program from such maps which would designate specific parts of the road network as no-salt or minimum-salt zones.

- Identification and site-review of snow-dumping areas.

- Training of highway crews both in salt application procedures and posting of sings for safe public vehicle operation.

- Education of local citizens about their responsibility during winter driving conditions.

Fortunately, the Commonwealth of Massachusetts is one of only two New England states to enact legislation limiting sodium standards for drinking water (Connecticut is the other).[1] This legislation, along with mutual concern by the communities within the Lower Charles Basin are important steps in protecting water supply from sodium contamination.

Sodium Chloride in Public Drinking Water - The Massachusetts Department of Public Health (MDPH) conducts regular analyses of small public water supplies about three times per year, and more frequently if data warrants monitoring of special problems. Although chloride concentration has been recorded for decades, statewide monitoring of sodium in water supplies began about 1969.

Some towns have many wells that draw from different aquifers. Not only does water quality vary between local aquifers but wells may not contribute equally to the local water distribution system. Usually some wells are kept in nearly constant production, others are activated during peak-demand periods, and a few, commonly those producing the poorest quality water (though not necessarily due to salt), are used only during emergency.

Landfill Problems - This section discusses the general mechanisms involved in landfill impacts on water quality and provides a brief summary of the condition and status of solid waste disposal facilities in the Upper Charles River Basin.

There are over 200 existing and abandoned landfills and dumps in the MAPC's 208 area. Domestic garbage and trash, industrial chemicals and metals, as well as sludge from septic systems and treatment plants, are dumped at some of these sites and buried. In distinction to the "dump and cover" operations, sanitary landfills are less apt to contribute to water pollution problems since the fill is covered daily, well graded, and large areas of the fill are sealed once the capacity is reached.

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[1] Taylor, F.B. Overview of New England Water Supply Problem p. 174 March 17, 1977.

Not all the landfills are sanitary, however, and improperly operated and sited landfills can be a significant water pollution problem. If the fill is not properly protected from rainfall, water will percolate through the refuse and leach out much of the toxic material. The resulting substance - known as leachate - flows to ground and surface waterbodies. It is highly toxic and contains a mixture of organic and inorganic materials as well as living micro-organisms.

Components of Leachate

metals - iron, zinc, manganese, lead, sodium, chromium, arsenic

sulfates
chlorides
calcium
phosphate
oxygen-demanding substances
oil and grease
phenols

According to the results gathered by one researcher one gallon of leachate from a two to six year old landfill contains 400 times the mandatory limit for iron concentration based on federal safe drinking water standards. In other words, one gallon of leachate would contaminate 400 gallons of water with excessive amounts of iron.

Leachate problems are often compounded by improper siting or maintenance of the landfill. In past years landfills were often located on marginal lands - lands that had a low economic value (wetlands or wet soils, for example). Drainage in these soils is poor and the refuse often comes in direct contact with the groundwater and thereby pollutes it. Old gravel and sand pits are also frequently chosen as landfill sites because of the ready availability of cover material. Many of these sandy areas are aquifer recharge areas, however, and as such, they are not suitable landfill sites. Water percolates through these recharge areas to replenish the groundwater reservoir which underlies them; contamination of groundwater is a particularly severe problem in these recharge areas.

Landfills are often sanitary only in that the refuse is buried and is, therefore, safer from rodents and insects than in an open dump. Yet not all cover material is equally effective in preventing the generation of leachate. If a coarse, sandy cover is used, water will percolate rapidly through the fill and the production of leachate will be maximized, whereas a clay or other impervious cover will be more effective in keeping water from leaching through the refuse.

Unless abandoned landfills are carefully sealed with clay or other impervious materials, leachate generation can continue for many years. One study points out the case of a fill in Germany where leachate pollution from a closed fill lasted for eighteen years.

Presently operating landfills exist in six of the fourteen communities of the Lower Charles River Basin. Included are Boston, Lexington, Lincoln, Needham, Natick and Weston. With the exception of the Weston landfill, each of these sites were originally at least partially within wetlands, although present operations are restricted to dry portions of each site. As a result of improved operating conditions in recent years, most of these facilities are expected to remain in operation for at least several years. Exceptions include Lexington, which may be ordered closed by the Mass. DEQE for violations of state landfill regulations.

In addition to these operating facilities, former landfills exist in the remaining eight towns of the basin. Some of these sites are still used on a limited basis for the disposal of such items as brush, stumps, and road construction debris. None of these sites has as yet, been sealed and capped in the manner specified by state landfill regulations, although several communities are planning, or proceeding with, some form of closing operation or site preparation for future development.

The landfills which have been or will be closed in the near future should be properly graded, compacted, sealed, planted and drained to prevent long-term degradation of local water resources. Similarly, the landfills remaining in operation should be operated in conformance with state regulations for the disposal of solid wastes by sanitary landfill. (The section of Community Profiles found later in this chapter provides more detailed information on each disposal site and the measures which should be taken to minimize impacts.)

D. POTENTIAL POLLUTION PROBLEMS

A vital aspect of 208 planning is its mandate to look into the future, to identify potential problems and to find ways to avoid them. Failure to do so will result in costly repetition of pollution problems and continued failure to get full benefit from out valuable water resources.

Local governments presently exercise significant control over the rate, type and density of growth; but, water quality is seldom considered in these decisions. In following chapters, the tools available to prevent pollution are discussed at length. The MAPC 208 project has also developed a significant amount of data and maps which help identify areas where development should be banned or conditioned to avoid damage to water qulaity. This information has been compardd to current zoning and to projected growth patterns to give further giidance to local governments.

Based on our study of the causes of pollution and of the character of the Lower Charles River Basin, we have identified several potential problems which deserve the attention of citizens and local officials.

Potential Point Source Problems - Three types of potential point source problems have been identified in the basin; a) additional discharges from storm drainage systems, b) effects of changes in existing and proposed wastewater treatment facilities, and c) possible additional industrial discharges.

a) Although population in the Lower Charles River Basin as a whole is expected to stabilize between 1975 and 1995, additional stormwater systems expected to be constructed in some communities would result in greater volumes of stormwater and more pollutants in water bodies.

b) The effects of planned changes of existing wastewater treatment plants (expansion and upgrading of harbor treatment facilities with or without mid-Charles satellite treatment faciltiy) should result in improved overall water quality. Nevertheless, such questions as the following are raised:

   - Will the highly-treated discharges enhance the river's water quality enough to allow swimming and fishing?

   - Will it be cost effective and environmentally beneficial to provide secondary treatment to wastewater at the Boston Harbor facilities before discharging the effluent into the ocean?

- Is the cost to provide high levels of treatment worth it to a community with no river frontage?

c) With a projected employment increase of 26 percent for the coming twenty-year period, there will be an expansion of industry albeit largely in the service category. Unless properly sited and managed, deterioration of water quality could result.

Potential Non-Point Source Problems - The most important potential problems from non-point sources in the Lower Charles River Basin are: a) increasing stormwater runoff, b) septic system failures from inappropriate location in future development, and c) loss of critical natural areas.

a) Many streams, lakes and ponds in this basin are not protected sufficiently from incompatible development which is likely to occur on their banks. Stormwater runoff is presently a threat to these waterbodies, and, as urbanization in the basin continues, it will become a more serious problem. During periods of precipitation, large quantities of dirt, oil, grease and salt from roads and parking lots are washed into streams, ponds and lakes; fertilizers and organic waste materials also run off the land to surface waterbodies and fertilize ponds and lakes, thereby causing excessive weed growth. The problem will undoubtedly worsen with time unless all communities adopt programs aimed at promoting proper drainage and preventing undesired stormwater runoff from entering waterbodies.

Communities should carefully examine existing storm drainage systems, as well as subdivision regulations which deal with the provision of those systems. A determination should be made on the best methods to employ in order to control this problem in newly developed areas.

Detailed MAPC recommendations for stormwater management systems and programs are in the process of being prepared. Final proposals, largely dependent of water quality monitoring programs now underway, will be included in the 208 Areawide Plan. Recommendations of the EMMA study are also being studied.

b) In order to identify those areas in the basin where septic system problems are likely to occur in the future, the natural land capability - including soils limitations for septic systems - was compared to the expected future uses of the land (based on current zoning.) The problem areas that were identified are those lands which are likely to experience septic system failures if developed according to the uses and densities permitted under current zoning. Although existing septic system problem areas were discussed earlier in this chapter, it is useful to point out here, that many of the existing problem areas are in fact examples of past conflicts between zoning and environmental capability which were unknown or now appropriately handled at the time. For example, many of the existing septic system problem areas identified in Natick and Weston occur where soils with severe limitations for septic sytems have been utilized for on-site waste disposal.

c) The water resources in several communities in the basin are not sufficiently protected from incompatible development. Wetlands and floodplains provide invaluable natural pollution treatment functions and if these lands are eliminated, serious water pollution problems can result. The loss of these lands is a potential non-point source problem of considerable magnitude in several towns. The significance of the loss is likely to become greater as population growth and future development throughout the Metropolitan area place an even greater pressure on our open space and local ground and surface water supplies.

d) Degradation of groundwater is a potential problem in parts of the basin. About half of the basin communities rely heavily on groundwater for municipal water supplies. Great quantities of water are contained in aquifers underlying the basin. These aquifers are comprised of large amounts of sand and gravel, exceptionally permeable materials. Water is absorbed by the soil and substrata and percolated down to the supply of groundwater, thereby replenishing or recharging it. Development which occurs on areas of natural groundwater recharge areas can have two principal impacts:

- large areas of impervious surfaces such as buildings, streets and parking lots eliminate aquifer recharge areas;

- leachate from landfills, runoff from stockpiles of salt or chemicals, and effluent from septic systems can contaminate groundwater supplies.

E. COMMUNITY PROFILE

This listing of water quality problems and issues by community is intended to help the citizens and local officials of each town in the basin understand the tasks they must deal with. The breakdown of this information into community specific blocks is consistent with the fact that most of the authority to correct or prevent problems lies with local governments. This should not obscure the equally important facts that ground and surface waters do not follow municipal boundaries and that solutions must be aimed at solving and preventing problems for the basin as a whole even if the implementation of those solutions is largely a local responsibility.

For discussions of the solution options available for the problems identified, the reader is referred to:

- Chapter 4 for options applicable to specific problems by community.
- Chapter 5 for an assessment of how the options can be combined into a comprehensive management program.
- Appendix C for general background or what options are available and how they work.

In addition, because of the necessarily site-specific nature of the short-term solutions to landfill and stormwater, some discussion of these solutions appears in the community profiles section of this chapter where the problems are identified.

BELMONT: EXISTING AND POTENTIAL PROBLEMS

Municipal Sewerage Facilities - The town has a sewerage system that serves about 95 percent of the population. Wastewater is discharged to the MSD system and treated at the Deer Island treatment facility.

Overflows - There is one pumping station in the Belmont sewer system that has an overflow facility. The overflow is available in the event of a power outage. The station does not have an emergency power source but an alarm system is connected to the police station. The alarm system has been used twice and no overflows have occurred. The overflow pipe is connected to a storm drain that leads to Clematis Brook.

Industrial Discharges - The Belmont Springs Water Company has been issued an NPDES permit to discharge 1,000 gpd of bottle washwater to a storm drain in Belmont, tributary to the Charles River.

Landfills - The Town of Belmont formerly operated an incinerator and ash landfill off Concord Avenue on the Waltham town line. Presently, disposal at this site is limited to brush and road construction debris.

The site and the adjacent wetlands are drained by Beaver Brook which flows south and then west to Lyman Pond in Waltham. Although the site has not been closed and sealed in the manner prescribed by state regulations, town officials report no evidence of leachate contamination in site drainage. The site should be monitored to assess potential continuing impacts and the need for remedial measures.

Municipal solid waste in Belmont is presently hauled directly to a private disposal operation based in Holliston. Commercial waste is separately hauled out of town from a trauefer station.

Concerning future disposal operations, Belmont is a member of the 128 West Refuse Recovery Council which is working towards the implementation of a regional facility plan to meet future long term solid waste disposal needs.

Failing Septic Systems - Approximately 5 percent of Belmont's population relies on septic tanks or cesspools for wastewater disposal. The Belmont Board of Health, which is responsible for individual disposal systems, reported that there are no chronic septic system problem areas within the town. Areas currently using subsurface disposal systems are known to have generally large-sized lots.

Septage Disposal - The town does not license pumpers, but septage pumped within Belmont is disposed of in a sewer manhole near the highway garage. Based on an existing population at 1,400 served by septic tanks, an estimated 220,000 gals. of septage would be generated per year (600 gpd.). However, this figure could be significantly increased if a large number of septic system failures occur (and consequently septic tanks are pumped more frequently).

On-lot Sewage Disposal - Potential problems for subsurface wastewater disposal could occur in those few areas of Belmont that are still unsewered. The soils are generally unsuitable for septic tanks and leaching fields and the residential zoning density is for small-sized lots, 2 to 4 dwelling units per acre. This lot size reduces the possibility of finding a suitable soil condition for safety locating a septic tank and leaching field. If these problems do occur, since Belmont is so widely sewered, a viable solution would be to extend the sewer service to these areas. Until this is accomplished, the systems should be regularly inspected, to control adequate maintenance and pumping procedures. Water conservation measures should also be encouraged.

Surface and Groundwater Protection

Belmont presently does not have any natural resource zoning districts for the protection of water quality and quantity. Wetlands, which are subject to flooding, occur along Beaver Brook and along the Alewife River downstream of Little Pond. Belmont should consider adopting a wetland protection district for these remaining areas of wetlands in the town.

Belmont relies on the MDC for its water supply. There are no known areas with high favorability for groundwater.

BOSTON: EXISTING AND POTENTIAL PROBLEMS

Municipal Sewerage Facilities - The city has extensive systems of separate and combined sewers that serve almost 100 percent of the population. During dry-weather, wastewater is discharged to MDC facilities for treatment at the Deer and Nut Island treatment plants. Wet-weather wastewater flows in excess of the systems' capacities are discharged to local waters from 125 points (see Overflows).

Approximately 74 percent of the city's population is tributary to the Deer Island treatment facility. This includes all of Boston Proper, Brighton, Charlestown, East Boston, Roxbury, and South Boston, and parts of Dorchester (81 percent), Fenway - Jamaica Plain (79 percent), Mattapan, and Roslindale.

The remaining 26 percent of Boston's popluation is served by the MSD interceptor system that is tributary to the Nut Island treatment facility in Quincy. This includes all of Hyde Park and West Roxbury, nearly all of Mattapan and Roslindale, and smaller parts of Dorchester (19 percent) and Fenway - Jamaica Plain (21 percent).

The major problem with much of the Boston sewerage system is its age. Most of the interceptors were constructed before 1900 and, consequently, many reaches of these sewers are structurally in poor condition. Infiltration to these sewers (and the smaller collectors) was fould to be much greater than the maximum design infiltration rates. In addition, the age problem is compounded by the accumulation of of storm debris, sedimentation, and inadequate sewer gradients (slope) in low-lying and landfill areas. In many areas, the sewer system is frequently discharged from sanitary wastewater, stormwater and tidewater.

In accordance with its NPDES discharge permit, Boston has established routine operating procedures and initiated combined sewer separation projects to reduce the discharge of pollutants from combined sewer overflows. The operating procedures consist of regular inspections of tide gates, dual manholes and overflow regulators, and the monitoring of the Calf Pasture pumping station and Moon Island discharge (see Overflows). In addition, there are current contracts for the removal of sediment from the Dorchester and South Boston interceptors.

Combined sewer separation projects have been in progress in four major areas. These projects are a part of construction for Boston Redevelopment Authority (BRA) urban renewal areas. Facilities plans were prepared for these projects in 1975 and recommended EPA funding for separate sanitary sewers and storm drains. Construction has been halted due to lack of funding. Separation of combined sewers in the South Cove Urban Renewal Area is about 66 percent complete. This project will alleviate the surcharging in the East Side interceptor and eliminate some combined sewer overflows to Boston Harbor. The Downtown Waterfront Urban Renewal Area is about 90 percent separate at this time. When completed, the combined overflows along the waterfront will be eliminated. The Charlestown Urban Renewal Area is currently 50 percent separated and two overflows bave been eliminated. Some funding was made available from HUD, but EPA funding is sought to complete the project. The South End Urban Renewal Area is about 20 percent separated at this time. One part of this project is the construction of the Union Park Street Pollution Abatement and Flood Control Facility. This facility is to be built in two phases.

After completion of the first phase, stormwater and combined sewer overflows from outside the project area will be diverted to the Facility and chlorinated. Light wet-weather flow will be discharged to the East Side interceptor and extreme wet-weather flows can be either chlorinated and pumped to the Roxbury Canal conduit or bypassed directly to the Roxbury Canal conduit. Phase II will add detention tanks, fine mesh screening, solids removal and skimming.

Although the separation projects have reduced the overflow of combined sewage from the project area, combined wastewater from adjacent areas is discharged to the new storm drains. This will continue until the adjacent areas have been separated.

A project to replace several major interceptors was recommended in the 201 facilities plan and is included in Boston's NPDES permit implementation schedule. The replacement of the Boston main interceptor and the East Side interceptor will relieve the hydraulic and structural problems mentioned previously.

Overflows - The city of Boston has been issued an NPDES permit for the discharge of untreated wastewater, combined sewage, and stormwater with possible sanitary flow from 125 points. The type of discharge and the number of discharges to the respective receiving waters is given in the following table.

Table 3-1

PERMITTED DISCHARGE FROM THE BOSTON MUNICIPAL SEWER SYSTEM

Receiving Water/ Type of Discharge	Combined Sewer Overflow	Untreated Wastewater	Stormwater w/ Possible Continuous Sanitary Flow
Boston Harbor	24	-	4
Chelsea River	3	-	1
Mystic River	3	-	2
Millers River	4	-	-
Charles River	11	1	8
Muddy River	-	-	3
Back Bay Fens	-	-	2
Fort Point Channel	10	-	4
Neponset River	7	1	20
Dorchester Bay	2	1	2
Rescove Channel	4	-	1
Old Harbor	7	-	-

Several overflows have been abandoned or eliminated since the permit was issued. These include two combined overflows to the Millers River, a combined overflow to the Neponset River and two stormwater discharges with possible sanitary flows to Boston Harbor. In addition, the proposed separation projects in the BRA urban renewal areas will eliminate or rehabilitate a number of overflows to Boston Harbor. Improvements to the Boston Main drainage system will eliminate many of the overflows to Fort Point Channel and Boston Harbor.

At present, though, Boston's combined sewer overflows contribute to the severe water quality degradation in the Charles Basin, Boston Harbor and the Neponset River. Probably the most significant effect of this pollution is the closing of bathing and shellfish harvesting areas in Boston Harbor.

During extreme wet-weather, the Calf Pasture pumping station is used as a bypass for the MSD-Deer Island system. When the Deer Island facility becomes overloaded, the gates at the Columbus Park and Ward Street headworks are partially closed to restrict the incoming flow. The wastewater backs up in the Boston main interceptor, the tributary interceptors and the combined sewers. The city is then notified by

MDC and the Calf Pasture pumping station is activated. Wastewater is pumped to the Dorchester Bay tunnel and flows from there to the Moon Island outlet works. The wastewater is supposed to be detained in Moon Island until the outgoing tide, but facilities are available for direct discharge. The city is required to provide chlorination during the warmer months for the Moon Island effluent. The city is also required to notify the Quincy Commissioner of Public Health of any bypass discharge. The Quincy Health Department closes Quincy's beaches after a discharge.

Industrial Discharges - The discharges from the industrial sources located in Boston affect the water quality in the Mystic River, the Neponset River and Boston Harbor, as well as the Charles River. Therefore, the industries have been grouped by the respective receiving waters.

Discharges to the Charles River and tributaries:

The Barnstead Company has been issued an NPDES permit that allows two discharges of uncontaminated cooling water to the Charles River. The total flow from the discharges is 0.3 mgd and the maximum allowable temperature in 65°F.

Boston Sand & Gravel is permitted to discharge concrete slurry washwater to the Millers River, a tributary of the Charles Basin. Teh company's permit established an effluent limit for total suspended solids, sulfates, and turbidity; and required Boston Sand & Gravel to investigate the feasibility of eliminating the discharge.

Dicharges to Boston Harbor:

The Great Atlantic & Pacific Tea Co. (A&P) and the Gillette Co. are permitted to discharge uncontaminated cooling water to Boston Harbor and the Fort Point Channel, respectively. A&P is allowed to discharge 1.1 mgd at 81°F. The Gillette Co. is permitted to discharge a total of 60.5 mgd at 83°F from four outfalls. The Gillette Co. discharge has been upgraded.

Bethlehem Steel Corp. has been issued an NPDES permit to discharge cooling water, boiler blowdown and stormwater from fourteen outfalls to Boston Harbor. Ten of the discharges consist entirely of uncontaminated cooling water. Two of the other discharges have a maximum allowable temperature of 83°F. Another discharge has a temperature limit of 100°F and a limit for oil and grease, as well. The remaining discharge consisted of boiler blowdown and was supposed to have been eliminated.

Three power generating facilities have been issued permits to discharge cooling water and assorted wastewater from boiler room drains, boiler blowdown, condenser backwash, etc. The Boston Edison - L St./New Boston Station is permitted to discharge 490 mgd of cooling water from two outfalls to the Reserve Channel. A limit of 0.1 mg/l of total residual chlorine was established for these discharges. The Boston Edison permit also includes nine other discharges with a total flow of 55.2 mgd. Each of these discharges has specific effluent limitations. The Massachusetts Bay Transportation Authority has two power stations that have been issued permits to discharge to Boston Harbor. The MBTA - Lincoln Power Station has four outfalls. The major discharge comes from the cooling system. About 30 mgd is discharged at a maximum temperature of 90°F. Residual chlorine can be no greater than 0.2 mg/l. The other three discharges contain boiler blowdown and the drainage from the boiler room. The MBTA - South Boston Power Station has several discharges which contain floor drainage and boiler blowdown as well as cooling water. The main discharge of cooling water has a flow of 43 mgd and a temperature of 71°F.

Logan International Airport, Seaboard Enterprises, and White Fuel Corp. have been issued permits to control the effects of stormwater runoff from their respective properties. Each is required to provide facilities that are capable of removing the oil and grease from the runoff. A limit of 15 mg/l of oil and grease was included in the firm's permits.

New England Aquarium has been issued an NPDES permit for the discharge of circulating water from the display tanks. The discharge is chlorinated prior to discharge. The average flow is 0.06 mgd.

The Thompson Academy, located on Thompson Island, has a secondary treatment facility that discharges to Boston Harbor. The facility serves the students at the school and treats an average flow of 20,000 gpd.

Discharges to the Mystic and Chelsea Rivers:

Distrigas of Massachusetts is permitted to discharge 2,000 gpd of uncontaminated cooling water at 83°F to the Mystic River. U. S. Gypsum Co. has an NPDES permit that allows the company to discharge 2.57 mgd of uncontaminated cooling water at 75°F to the Mystic River. U. S. Gypsum also has two other discharges. One is a process wastewater and the other contains sanitary wastes. Both discharges have treatment requirements and limitations for certain wastewater constituents.

Mobil Oil Corp. and Amerada Hess Oil and Chemical Corp. have been issued NPDES permits for the control of stormwater runoff from the respective properties to the Chelsea River.

These companies are petroleum distributors and they are required to install oil separators in their storm drainage systems.

The Amstar Corp., a sugar refiner, has been issued a permit for two discharges consisting of cooling water, stormwater runoff, and steam condensate. The cooling water originates from the barametric condensers and has an average flow of 10.5 mgd. to the Mystic River. The other discharge has a flow of 805 gpd. Treatment is required for both discharges.

The Revere Sugar Refinery has been issued an NPDES permit for two discharges to the Mystic River. The two discharges consist of cooling water and the wastewater from the air scrubber system. No flow figures were available but the maximum temperature allowed is 90°F. Limits on suspended solids and BOD were also established.

The Schrafft Candy Co. has two permitted sischarges to the Mystic River. One discharge consists of cooling tower blowdown and compressor cooling water and has an average flow of 0.15 mgd. The second discharge is the turbine cooling water. This discharge has a temperature of 70°F and an average flow of 4.32 mgd.

The Boston Edison - Mystic Station has a permit that allows eleven discharges to the Msytic River. The main discharge consists of 927.5 mgd of cooling water at 93°F. The other ten discharges contain boiler blowdown, equipment washwater, floor drainage and the like. Treatment facilities to remove metals, solids, and oil and grease are required for these discharges.

Discharges to the Neponset River:

Westinghouse Electric Corp. and Magnesium Casting Co. have NPDES permits for cooling water discharges to Mother Brook. Westinghouse Electric discharges 8,500 gpd of uncontaminated cooling water at 100°F. Magnesium Casting Co. discharges 0.55 mgd of cooling water at 83°F from three outfalls. These have no treatment requirements.

Ho Hop Pavements, Inc. has an NPDES permit for the discharge from the sedimentation basin to the Neponset River. The company is permitted to discharge 108,000 gpd at a maximum temperature of 83°F. The permit also establishes certain effluent limits for suspended and settleable solids and oil and grease.

Landfills - The City of Boston presently disposes part of its municipal solid waste at a large city operated landfill off Gardner Street in West Roxbury. The facility is bordered by the Charles River to the West, Sawmill Brook to the north, and the Penn Central Railroad to the south. The site drains to the Charles River wither directly, or indirectly by via Sawmill Brook.

Present impacts of this facility are unknown, since the site has not been recently inspected or monitored. The most recent study of this facility, conducted in 1971, found that groundwater leaving this site was not severely contaminated despite leachate contamination within and beneath the landfill.

This facility is scheduled to be phased out in several years assuming the availability of acceptable disposal alternatives. Considering the size of this facility and its proximity to the Charles River, monitoring should be conducted to assess the need for remedial measures at the time of closing of the site and during the interum period of operation.

In addition to the Parduer St. landfill, Boston utilizes four private regional disposal facilities outside of the city. These include RISSCO in Saugus, a landfill in Plainville, an incinerator in East Bridgewater, and a trauefer station in Cambridge.

Long range disposal places are indefinite, although consideration is being given to regional resource recovery options including construction of a municipal facility or participation in the 128 West Refuse Recovery project.

BROOKLINE: EXISTING AND POTENTIAL PROBLEMS

Municipal Sewerage Facilities - The town has a sewerage system that serves almost 100 percent of the population. About 53 percent of the town's dry-weather wastewater is discharged to the MDC-Charles River Valley sewer and treated at the Deer Island treatment facility. The other 47 percent of the town's wastewater is discharged to the MDC-Brighton Branch sewer and the MDC-Upper Neponset Valley sewer for treatment at the MDC-Nut Island facility.

In addition, about 10 percent of Brookline's system consists of combined sewers. There are no overflows from the Brookline sewer system but an overflow can occur at the MDC operated facility at St. Mary Street and Commonwealth Ave. The town has no current plans to separate the combined sewers.

Landfills - Brookline formerly incinerated municipal solid waste and landfilled the ash residue at a facility off Newton Street in the western section of town. Although the incinerator was closed in 1975, the landfill still receives leaves and chipped brush which is used as mulch over the sand and gravel cover material. Planting of the fill surface is planned after the mulch has decomposed.

Although the landfill has not been closed and sealed as specified in state regulations, town officials report that there are no leachate problems at the site. Drainage of the site may, in part be subsurface, as the surface drainage network of the area is poorly integrated. Water quality monitoring should be conducted at this site to determine the presence or absence of impacts and the need for remedial measures.

Solid waste is presently hauled out of town and disposed of at a private regional landfill in Plainville. Although not a member, Brookline is an observer of the 128 West Refuse Recovery Council which is working toward the implementation of a regional facility for long-range solid waste disposal.

Surface and Groundwater Protection - Brookline presently does not have any natural resource zoning districts for the production of water quality and quantity. Although the State Wetlands Protection Act gives some protection to the town's wetlands by allowing the Conservation Commission to regulate alterations in a wetland, the establishment of a wetland protection district would give additional protection for it could prohibit future development within a wetland area. The banks of the major rivers, the Charles and the Muddy River are in public ownership but this does not protect them from pollution and flooding problems aggravated by urban runoff and combined sewer overflows. A buffer district including and extending beyond the flood hazard areas could contain development controls, further outlined in Appendix C, to help mitigate these existing problems. The smaller streams in Brookline should also be included in this district.

The major waterbodies and their shorelines are largely protected either by being in public ownership, such as Brookline Reservoir, Halls Pond and Leverett Pond or by acquisition of a conservation easement, Sargent's Pond.

Brookline relies on the MDC for its water supply. There are no known areas with high favorability for groundwater.

CAMBRIDGE: EXISTING AND POTENTIAL PROBLEMS

Municipal Sewerage Facilities - The city has an extensive system of combined and separate sewers that serve the entire population. Dry-weather wastewater flows are discharged to the MDC facilities for treatment at the Deer Island treatment plant. Wet-weather flows in excess of the municipal system's capacity overflow to the Charles River and Alewife Brook (see Overflows).

The Cambridge sewer system is subject to significant infiltration of groundwater through deteriorated sewer joints and, in some cases, collapsed sewers. This is generally caused by the age of the particular sewers and the materials used during construction. Many of the older sewers were built using wood and some of these are badly rotted. Inflow enters the Cambridge system from faulty tide gates and regulating structures. Improper house connections, relief connectors between sanitary sewers and storm drains, and missing separation plates in dual manholes are also problems. These conditions can result in the discharge of sanitary wastes to surface waters during dry-weather. In addition, stormwater discharged to separate systems decreases the carrying capacity of the sanitary sewer and may cause overflows in downstream areas. A program to correct many of these problems is currently in progress.

The city's NPDES discharge permit has an implementation schedule for separation of the combined sewers. This schedule was developed from a report by C.E. Maguire, Inc. that recommended a five-phase program that would eliminate some local problems and reduce or eliminate the combined sewer overflows. Phases I and II of this program have been completed. Phase I consisted of separation of the combined sewers in the Pearl Street area. Phase II separation was located in the northwestern area of the city near Alewife Brook and in an area around Massachusetts Avenue, between Central Square and Albany Street. Phase III improvements are presently underway and consists of separation in the area bounded by Cambridge Street, Portland Street, Binney Street and First Street; and in a smaller area near Carlisle Street. Phase IV is presently awaiting EPA approval and consists of separation in an area just east of Lowell Street and in the area west of Aberdeen Avenue. This phase will eliminate one overflow completely and reduce the frequency of discharge from the Lowell St. overflow. Phase V will separate sewers in the area bounded by Chauncy Street, Massachusetts Avenue, Upland Road and Garden Street.

Overflows - The city of Cambridge has been issued an NPDES discharge permit for 19 combined sewer overflows. These overflows are significant contributions to the water quality degradation of the Charles Basin and Alewife Brook.

Alewife Brook receives the combined wastewater from four overflows in the northwestern area of the city. Phase II construction reduced the frequency of discharge from these four overflows to storms with return periods greater than 5 years. However, storms with return periods greater than 5 years will continue to pollute Alewife Brook and the Lower Mystic River.

Cambridge has thirteen permitted overflows to the Charles Basin. Seven of these have been eliminated or the frequency of their discharges reduced by the construction of relief facilities. The MSD-North Charles relief sewer (see Summary-Overflows) currently collects the combined sewer discharges from six of the seven overflows and transports the wastewater to the MSD-Cottage Farm detention and chlorination station. From here, the wastewater is either diverted to the Deer Island interceptor system or, if the flows are excessive, discharged to the Cottage Farm facility for treatment and discharge to the Charles Basin. The seventh overflow was blocked off and the combined flows routed to the Cambridge marginal conduit for discharge below the existing Charles River Dam. The six combined sewer overflows that remain continue to cause significant water quality problems in the Charles Basin. The completion of the MSD-North Charles relief sewer from Plympton Street west to Lowell Street should eliminate the overflows to the Basin caused by storms with a return period of less than 5 years (the relief sewer will intercept only a 1-year storm from the overflow at Lowell Street until the combined sewer separation program in the Aberdeen Street area is completed).

In addition, there are two combined sewer overflows from Cambridge that discharge to the tidal portion of the Charles River, below the existing dam. These overflows will be eliminated when the MSD-Charles River marginal conduit project is completed.

Cambridge is currently separating combined sewers in several areas of the city. The purpose of this project is to reduce the combined wastewater flows to the MSD-North Charles relief sewer. This will increase the carrying capacity of the relief sewer and decrease the frequency of overflows to the Charles Basin. The separation projects will also reduce or eliminate the combined sewer overflows in other areas of the city not served by the relief sewer.

Industrial Discharges - The Cambridge Electric Light Company has two power stations that have been issued NPDES permits to discharge cooling water to the Charles Basin. The Blackstone Street Station is permitted to discharge 24.5 mgd of colling water at a maximum temperature of 105°F. The Kendall Square Station has four cooling water discharges to the Charles Basin. The total discharge is about 105 mgd at 105°F. The power stations are required to limit the amount of free chlorine residual in the discharge. The chlorine is used to control algal growth in the condensers.

The Massachusetts Institute of Technology has been issued a permit to discharge uncontaminated cooling water from four sources to the Chalres Basin. The sources of the cooling water include the wind tunnel, the magnet lab, the power plant and various air conditioning units. The total flow from the four discharges is 10.2 mgd and the maximum allowable temperature is 80°F.

Dewer & Almy Chemical Division (a division of W.R. Grace & Co.) is permitted to discharge uncontaminated cooling water to Fresh Pond Brook, a tributary of Alewife Brook. The permit allows a discharge of 0.3 mgd at a maximum temperature of 68°F.

Landfills - The City of Cambridge formerly operated an incinerator near Porter Square and an ash landfill off New Street near Alewife Brook. Present use of the landfill site is limited to dumping of snow. The landfill has been graded and covered with solid fill, but has not been sealed and planted as specified in state regulations.

Future plans under consideration for the site include development of athletic facilities after the site has settled for a period of several years.

Although no leachate seepage from the facility has been reported, site drainage should be sampled to assess potential impacts and the need for remedial measures.

Presently, solid waste from Cambridge is hauled to disposal areas outside of the city from a privately operated transfer facility. There are presently no plans for other future disposal facilities.

Surface and Groundwater Protection - There are no significant wetlands in Cambridge that need protection. The flood hazard areas along the Charles River are largely in MDC park use. The water quality of Fresh Pond, Cambridge's water supply, is protected by a town park which surrounds the entire pond. There are no known areas with high favorability for groundwater.

DEDHAM: EXISTING AND POTENTIAL PROBLEMS

Municipal Sewerage Facilities - The town has a separate sanitary sewer system that serves about 90 percent of the population. Wastewater is discharged to the MSD system for treatment at the Nut Island facility.

Landfills - The Town of Dedham formerly operated a landfill off Washington Street near Mother Brook. The facility was closed in 1976 by order of the Mass. DEQE for violations of state landfill regulations. Although plans for closing and sealing have been submitted and approved, the sealing operation itself has not yet been completed.

The nature and extent of continuing leachate impacts from this facility on groundwater or on Mother Brook are uncertain, since no recent inspections or water quality surveys have been reported. The site should be monitored for evidence of water quality impacts prior to the completion of sealing to determine the need for specialized remedial measures. Monitoring should also continue after sealing is finalized to assess the adequacy of the closing procedures.

Presently, refuse is hauled out of town to a private regional disposal facility in E. Bridgewater. No plans have been reported concerning the use of other disposal facilities in the future.

Failing Septic Systems - Approximately 10 percent of Dedham's population is served by septic tanks or cesspools for wastewater disposal. The Dedham Board of Health which is responsible for individual disposal systems reported that there are no septic system problem areas. In 1975, the town reported one repair of a subsurface disposal system.

Septage Disposal - Two pumpers are currently licensed to pump and haul septage within Dedham. Septage is reportedly disposed of out of town. Based on an existing population of 2,700 served by septic tanks, an estimated 400,000 gallons of septage would be generated per year (1,100 gpd). However, this figure could be significantly increased if a large number of septic system failures occur (and consequently septic tanks are pumped more frequently).

On-Lot Sewage Disposal - Most of the unsewered areas of Dedham are unsuitable for subsurface disposal systems due to deposits of bedrock, hardpan soils, and areas with a high water table. Potential problems are likely to occur in these areas where residential zoning density has a minimum lot size of 12,500 square feet. This lot size reduces the possibility of finding a suitable soil condition for safely locating a septic tank and leaching field. If these areas remain at this zoning density and problems do occur, since Dedham is so widely sewered, a viable solution would be to extend the existing sewer service to these locations. If sewer extension is not considered feasible, the town should carefully control the location and design of new systems and enforce by inspection a schedule of regular maintenance and pumping. Water conservation measures should also be encouraged.

Surface and Groundwater Protection - Dedham has a floodplain zoning district that protects the land subject to flooding and most of the wetlands. The remaining wetlands are unprotected except by the State Wetlands Protection Act which does give authority to regulate development to ensure that development is made in an environmentally sound manner. To ensure that these wetlands remain undeveloped, Dedham should consider adopting a wetland zoning district.

Motley Pond and Weld Pond are presently not protected by any natural resource district. The land surrounding the ponds is zoned for moderate density residential use, and much of it is still undeveloped. Dedham could consider establishing a watershed protection district for the two ponds for the purpose of better monitoring how the land is developed. Buffer zones around the ponds with vegetative cover to absorb runoff and control erosion, limitations on the amount of impervious surface permitted and adequate surface drainage designs should be some of the major considerations.

Dedham relies totally on groundwater for their water supply, purchased from the Dedham Water Company. There are extensive areas noted for high groundwater resources underlying large areas of the town. Consideration should be given to establishing an aquifer protection district to protect the future water quality and quantity. Excessive paving brings urban runoff carrying pollutants to the surrounding land and likely to the groundwater and failing septic systems brings leachate to the subsoil and also likely to the groundwater. These are two of the situations that could be more effectively monitored with an aquifer protection district.

LEXINGTON: EXISTING AND POTENTIAL PROBLEMS

Municipal Sewerage Facilities - An extensive wastewater collection system serves about 80 percent of Lexington's population. Wastewater is discharged to the MSD system for treatment and the Deer Island facility.

Landfills - The Town of Lexington presently operates a landfill off Hartwell Ave. which is bordered by Route 128 to the southeast, the B & M railroad tracks to the northeast and Kiln Brook to the west. The site, which overlies wetlands in places, drains to the north via a branch of Kiln Brook which flows a distance of roughly one mile to the headwaters of the Shawsheen River.

At the time of the site visit (May, 1976) the facility had experienced a leachate problem as a result of site and operating deficiencies. These problems included steep side slopes, encroachment upon wetlands, and poor covering and grading practices. Water bodies potentially affected include Kiln Brook and the Shawsheen River. In addition there is some concern regarding potential impacts on downstream public wells located in Bedford and Burlington.

Although the facility has a reported remaining capacity of 3-5 years, the Mass. DEQE is ordering the closure of the facility as of January, 1978 due to violations of landfill regulations. According to town officials, steps have recently been taken to improve the condition of the facility including improved grading and cover. Water quality samples taken by the town were reported to indicate an absence of significant impacts on Kiln Brook. Although part of the site overlies wetlands, none have been filled since 1969.

Concerning future disposal, Lexington is a member of the 128 West Refuse Recovery Council which is working toward the implementation of a facility plan to meet long term regional disposal needs.

Failing Septic Systems - Approximately 20 percent of Lexington's population relies on septic tanks or cesspools for wastewater disposal. The soils in Lexington are generally unsuitable for individual disposal systems due to many areas with shallow and exposed bedrock or a high water table. However, the Board of Health, which is responsible for individual disposal systems, reports that there are no specific problem areas. The septic system problems are scattered throughout the town, requiring annually about 20 to 25 repairs. Most of these failures are reported due to lack of maintenance and age of the systems.

Septage Disposal - Eleven pumpers are currently licensed to pump and haul septage within Lexington. Septage pumped within the town is disposed of into a manhole on Bow Street near the Lexington-Arlington line. Based on an existing population of 6,500 served by septic tanks and 1,500 gal. septic tanks, an estimated 1,350,000 gallons of septage would be generated per year (3,700 gpd). However, this figure could be significantly increased if a large number of septic system failures occur (and consequently septic tanks are pumped more frequently).

On-Lot Sewage Disposal - Most of the unsewered areas of Lexington are unsuitable for subsurface disposal systems due to deposits of bedrock, hardpan soils or a high water table. Potential problems with future developments are likely to occur in these areas for the residential zoning density has a minimum lot size of less than 30,000 square feet. This lot size reduces the possibility of finding a suitable soil condition for safely locating a septic tank and leaching field. Some of the unsewered land with poor soil conditions is also zoned for commercial use. The probability of high density development and of large loadings generated by commercial use increases the likelihood of system failures. If these areas remain at this zoning density and use and problems do occur, since Lexington is so widely sewered, a viable solution would be to extend the existing sewer service to these locations. If sewer extensions are not considered feasible, Lexington could consider rezoning to a lower density and use. The location and design of new subsurface wastewater disposal systems should be strictly monitored and a schedule of regular maintenance and pumping should be enforced. Water conservation measures should also be encouraged.

Surface and Groundwater Protection - Lexington has many aspects in its land use regulations that operate to protect surface and groundwater. The wetland protection district has defined permitted and prohibited uses for protecting wetlands and maintaining the groundwater table. The Conservation Commission has a substantial program for open space acquisition with an emphasis geared towards wetlands. The few acres in town that are subject to flooding, particularly along Beaver Brook are included in the wetland zoning district.

Lexington relies on the MDC for its water supply, except for a few private wells. There are no known areas with a high favorability for groundwater.

LINCOLN: EXISTING AND POTENTIAL PROBLEMS

Non-Municipal Sewerage Facilities - The Lincoln Woods Cooperative Homes has a wastewater treatment facility that serves about 250 residents. The treatment facility began operation in 1976 and is an activated sludge package plant operating in the extended aeration made. Treatment consists of comminution, aeration, settling, chlorination, and sand filtration. The final effluent is discharged to sand infiltration beds for ground disposal. An NPDES permit is not required for a discharge to the ground. The plant is achieving BOD and total suspended solids removals of 93 and 85 percent, respectively. Greater Boston Community Development is responsible for the operation of the treatment facility. The superintendent of the Lincoln Woods development is the operator.

The total suspended solids in the final effluent exceeds the standards for secondary treatment. The maximum level of total suspended solids allowed in a municipal discharge is 30 mg/l. The facility is currently discharging an effluent containing about 54 mg/l of total suspended solids. However, the treatment facility is relatively new and it typically takes some time for the operation of a facility to stabilize. Other problems at the treatment facility include freezing sludge lines in the winter, leaf problems in the autumn and grease build-up on the baffles in the chlorine contact chamber.

Sludge - Excess activated sludge is discharged to an aerobic digestor three times a week. Sludge is pumped out and transported to Framingham for disposal in the MDC system.

Landfills - The Town of Lincoln presently operates a landfill to the south of Massachusetts Ave. near Folly Pond. The present site ahs been used for the past 7 years since moving form an adjacent area which was closed since it was encroaching upon Folly Pond which is now part of the Minuteman National Historic Park. Drainage of the site and the surrounding swampy area is poorly integrated and difficult to trace. Although town officials report that the site has been studied by a geologist, the drainage pathway is still indefinite. Possible routes include surface drainage via the adjacent wetlands to Hobbs Brook or subsurface drainage via the underlying sand and gravel deposits to the Shawsheen River. Drainage to Hobbs Brook would ultimately flow to the Cambridge Reservoir located less than one mile to the southeast.

Although at the time of the site visit (May, 1976) there was some evidence of leachate stains in adjacent wetlands, there is not reported to be a significant leachate problem at this site. The facility has not filled witnin surrounding wetlands, and a 3' berm has been constructed around the facility to provide a separation from the wetlands. Operations are restricted to areas above the water table and within the berm. Recent reported upgrading measures at the site include improved grading, compacting, and covering.

Although specific impacts of this facility have not been reported, several nearby shallow private wells experience occasional bacterial problems which are possible, but not likely due to the landfill.

Further monitoring and survey work should be considered at the site to determine the drainage pathway and potential impacts, particularly regarding Hobbs Brook which leads to a public water supply.

Town officials report that the facility operates under plans approved by the Mass DEQE and has several years of remaining capacity. Lincoln is a member of the 128 West Refuse Recovery Council which is working towards the development of a regional disposal facility to meet long term disposal needs.

Failing Septic Systems - Lincoln is entirely served by septic tanks or cesspools except for the cooperative homes served by their wastewater treatment plan and the Hanscom Air Force Base which is sewered to the MSD system.

Due to large lot zoning and strict adherence to design requirements of new systems, the town reportedly has very few septic system problems. There are no specific problem areas within the town, and most of the problems that do occur are the result of age and attrition of septic systems. The Board of Health is responsible for individual disposal systems.

Septage Disposal - Currently, four pumpers are licended to pump and haul septage within Lincoln. There are no septage disposal facilities, public or private, in the town. Lincoln contracts with the MSD to allow septage from Lincoln to be disposed of in an MSD sewer in Framingham. The MSD assesses Lincoln a fee of $1.25 per capita (FY 77) for septage disposal privileges (persons living on Hanscom Air For Force Base are not included in the assessment). Framingham levies a charge of $10 per 1,000 gal. of septage disposed of within its boundaries. Based on an existing population of 5,000 served by septic tanks, an estimated 620,000 gal. of septage would be generated per year (1,700 gpd). However, septage quantities could be significantly increased if a large number of system failures occur (and consequently septic tanks are pumped more frequently).

On-lot Sewage Disposal - Approximately two-thirds of the land area in Lincoln is underlain by soils that have moderate to severe limitations for subsurface wastewater disposal. However, since Lincoln relies on large lot zoning, there is adequate area within each site for finding soils suitable for a leaching field. With continuation of the town's policy of enforcing strict adherence to design requirements of new system and with regular inspection and maintenance, potential problems are unlikely. Water conservation measures should also be encouraged.

Surface and Groundwater Protection - Lincoln's land use regulations have many features for protection of surface and groundwater. The Open Space Conservation District includes all land subject to flooding and all land that overlies an area with high groundwater favorability. The wetland and watershed protection districts include all wetlands and are standing and flowing bodies of water. The subdivision regulations prohibit the alteratum of watercourses, ponds and wetlands. The stated purposes of these bylaws relating to water quality are for the protection of groundwater and recharge areas, the protection of the natural flow pattern for flood protection and floodwater storage capacity and the protection of water quality and quantity. Protection within these districts includes Lincoln's two water supply sources, Sandy Pond and the Tower Road well and the portions of the Hobbs Brook and Stony Brook watersheds which supply the two Cambridge Reservoirs, 90% of the water needs of Cambridge.

NATICK: EXISTING AND POTENTIAL PROBLEMS

Municipal Sewerage Facility - The town has a sewerage system that serves about 80 percent of the population. Wastewater is discharged to the MSD system for treatment at the Nut Island facility.

Industrial Discharges - An NPDES permit has been issued to the U. S. Army-Natick Laboratories for air-conditioning cooling water discharges to Lake Cochituate. The permit allows the Laboratories to discharge about 5.6 mgd from four points. The maximum permissible temperature is 83°F.

Landfills - The Town of Natick presently operates a landfill off Route 27 adjacent to the Sherborn town line. The site was developed in a wetland area which is primarily drained by Indian Brook which flows east through interconnected swamps for a distance of roughly three miles to the Charles River.

As a result of the original displacement of wetlands at this site, there is evidence of leachate stains in the wetlands which border the site on three sides. The present active portion of the facility is restricted to the internal area of the site which is not adjacent to wet areas. At the time of the site visit (September 1976) the facility appeared well graded to a mound shape, yet lacked impermeable cov er material, or loam and vegetation on older, inactive areas.

According to town officials, water quality testing conducted in the area has not demonstrated adverse effects. The facility operates under plans approved by the Mass. DEQE and is expected to remain in operation for about 10 years.

Water quality testing should be repeated occasionally at this site to assess the presence or absence of impacts, and inactive portions of the site should be sealed and planted.

Concerning future disposal, Natick is a member of the 128 West Refuse Recovery Council which is working towards the implementation of plans for a regional facility to meet long-term disposal needs.

Failing Septic Systems - Approximately 20% of Natick's population relies on septic tanks or cesspools for wastewater disposal.

Much of the land in Natick is unsuitable for subsurface wastewater disposal because of clay deposits, ledge, and a high water table. Low lying areas along Eliot Street in southern Natick adjacent to the Charles River and along Perry and Evergreen Roads on the eastern shore of Lake Cochituate are reported to be experiencing chronic problems with septic systems. The Natick Board of Health is responsible for individual disposal systems.

Septage Disposal - Eleven pumpers are currently licensed to pump and haul septage within Natick. Septage is disposed of into the MSD system at the septage disposal manhole on West Central Street (Route 135) near Fisk Pond in Natick. Based on an existing population of 6,200 persons served by septic tanks, an estimated 876,000 gallons of septage would be generated per year (2,400 gpd). This quantity could increase significantly, however, if a large number of system failures occur (and consequently septic tanks are pumped more frequently).

On-lot Sewage Disposal - Natick presently does not have a detailed soil survey which would indicate the areas in town that could have severe limitations for septic systems due to hardpan or wet soils or bedrock. However, judging from the overall soil conditions of the surrounding towns and town reported reasons for existing failures, limitations are likely.

Potential problems occur throughout all the unsewered areas of town for the land is largely zoned for residential use with permitted lot sizes hanging from 12,000 to 40,000 square feet. With the likelihood of poor soils, these lot sizes restrict the possibility of finding a suitable area for on-site wastewater disposal, if these residential zones remain in effect and are not sewered. There are several non-structural solutions that should be considered. Of high priority should be a detailed soil survey of the town. This would give guidance for adopting zoning densities that better reflect the environmental capacity of the land. Other non-structural options further discussed in Appendix C include careful review of septic tank design and location adopting a schedule of regular inspection and maintenance of the systems and encouraging water conservation measures.

Surface and Groundwater Protection - Natick has a floodplain overlay zoning district that protects the land subject to flooding by permitting uses other than conservation, recreation and agriculture, only by a special permit from the Board of Appeals. Natick has significant wetlands particularly in the eastern section of town along Indian and Davis Brooks and by Pickerel Pond. Adopting a wetland protection district would not only protect the wetlands from development but would also serve to protect the banks of the brooks.

Dug Pond has been reported to be deteriorating in water quality. Tributaries in its watershed are polluted, suspected sources being leachate from failing septic systems and urban runoff. Lake Cochituate has an active watershed association which has gained much local support in its efforts to improve the water quality of the lake. Its direction has been not only to the lake, but to the entire watershed. A further step could be for Natick to adopt a watershed protection district which would give control to future land use and density within its bounds.

Natick has a large area with a high potential for groundwater in the northeast section of town. There are four existing wells in this vicinity which supply part of the town's water neess. Most of this area is unsewered with moderate density zoning and use. To protect this water supply, in addition to the measures suggested for safe groundwater disposal, Natick should consider adopting an aquifer protection district including restricting development around the well sites.

NEEDHAM: EXISTING AND POTENTIAL PROBLEMS

Municipal Sewerage Facilities - Needham has an extensive sewerage system that serves about 85 percent of the town's population. Wastewater is discharged to the MSD system for treatment at the Nut Island facility.

Landfills - The Town of Needham presently operates a landfill off Central Avenue to the east of the WHDH radio towers. The site has, in past years, encroached upon wetlands to the north and west which are drained by Great Fuller Brook which flows a distance of roughly four miles to the north and west to the Charles River in Wellesley.

The presently active section of the fill is restricted to interior sections of the site located 60 feet or more from the adjacent wet areas. The peripheral areas adjacent to surface waters are covered and no longer active, yet, at the time of the site visit (September 1976) had not been properly sealed, loamed, and planted. The only evidence of leachate impact at this site are dead trees in the shrub swamp to the west of the site. Present operations may not be responsible for such impacts, as past filling in wetlands could account for leachate stressed vegetation. Limited testing performed by the town has failed to indicate any significant water quality impacts due to the facility.

The facility, which is 25 years old, has an expected remaining life of 9-10 years according to plans of operation approved by the Mass. DEQE. Maintenance of good operating conditions together with occasional water quality testing, should assure minimal impacts from this site.

Concerning future disposal, Needham is an observer with the 128 West Refuse Recovery Council which is working towards the development of a regional disposal facility to meet long term needs. Needham is also considering future construction of a transfer station to be used in conjunction with this, or another regional facility.

Failing Septic Systems - Approximately 15 percent of Needham's population is served by septic tanks or cesspools. The Board of Health which is responsible for individual disposal systems reported that there are no persistent problem areas. Homes experiencing problems are obligated to connect to a public sewer if available. However, homes that are within accessibility to a public sewer, but have no problems with subsurface disposal systems, are not required to connect to the sewer.

Septage Disposal - Three pumpers are currently licensed to pump and haul septage within Needham. An annual fee of Two Dollars is charged for the permit. Septage is disposed of at a sewer manhole on the MSD interceptor near the intersection of Greendale Avenue and Hamlin Lane. Based on an existing population of 4,500 served by septic tanks, an estimated 660,000 gallons of septage would be generated per year (1,800 gpd.) However, this figure could be significantly increased if a large number of septic system failures occur (and consequently septic tanks are pumped more frequently).

On-Lot Sewage Disposal - The soils in Needham are largely unsuitable for subsurface wastewater disposal due to shallow bedrock, hardpan, or wetlands. Potential problems with system failures could occur in this area where the residential zoning district has a minimum lot size of 20,000 square feet. This lot size, in an area with generally unsuitable soils, creates difficulties in finding a suitable location for on-site disposal. However, since Needham is largely sewered, and if problems do occur, their existing policy of obligating homes with problems to connect to a sewer line should help prevent serious pollution problems. Remaining systems should be regularly monitored for maintenance and pumping and new systems should be inspected for design criteria and site location. And, measures for water conservation should be encouraged.

Surface and Groundwater Protection - Needham has a floodplain overlay zoning district. The permitted uses are generally open space and passive uses of the land, plus those uses permitted in the overlaid district, subject to the provisions of the floodplain district. These provisions include flooding, the disposal of sewage and the soil structure. Needham's wetlands are protected by the State Wetlands Restrictions Act, adopted in May 1975. It is reported that the water quality of Rosemary Lake varies daily. A contributing cause is likely urban runoff. An addition to Needham's watershed protection district to monitor future development in the drainage area of the lake could be considered. This could impose criteria for limiting impervious surfaces and site drainage designs.

Seventy percent of Needham's water comes from ground-packed wells. There are several locations in town that are underlaid by areas having high groundwater favorability. They occur under areas that are subject to flooding and are presently protected by the overlay floodplain zoning district.

NEWTON: EXISTING AND POTENTIAL PROBLEMS

Municipal Sewerage Facilities - The city has an extensive sewerage system that serves about 80 percent of the population. Approximately 45 percent of the sewered population is tributary to the MDC-Charles River Valley sewer and the Deer Island treatment facility. This service area is generally located in the northern and northeastern areas of Newton. The remaining 55 percent of the sewered population is tributary to the MDC-Brighton Branch sewer, the MDC-Upper Neponset Valley sewer, and the MDC-Nut Island treatment facility.

Industrial Discharges - Community Service Stations, Inc., is permitted to discharge stormwater runoff to a brook that is tributary to the Charles River. Facilities to remove oil and grease from the runoff are required.

St. Regis Paper Co. is permitted to discharge equipment cooling water and boiler blowdown to a Newton city storm drain that is tributary to the Charles River. The permit allows the company to discharge 0.21 mgd at a temperature of 72°F from two points.

White Fuel Corporation is permitted to discharge treated stormwater runoff to Cheesecake Brook. Treatment consists of oil and grease separation.

Landfills - The City of Newton formerly operated an ash landfill off Rumford Avenue adjacent to the Charles River. The landfill was closed in 1975 when the municipal incinerator was closed for air pollution violations. In the last two years, the landfill has received, and has been covered by, solid fill including dirt, asphalt, etc.

The Mass. DEQE has reportedly inspected the site and its taking action to ensure that the site is sealed and planted in accordance with state landfill regulations. Some leachate is reported to be draining from the site to the adjacent river. Past filling in wetlands has, most likely, contributed to leachate production.

The site should be monitored to assess the nature and extent of measures required to properly seal the facility and mitigate any continuing impacts. Periodic monitoring after sealing is advisable to assess the adequacy of the closing procedure.

Newton presently uses, in conjunction with Waltham, a compactor and transfer station. Refuse is hauled after transfer to a private regional landfill in Amesbury.

Concerning the future disposal, Newton is a member of the 128 West Refuse Recovery Council which is working towards the development of a regional facility to meet long term disposal needs.

Failing Septic Systems - Approximately 20 percent of Newton's population is served by septic tanks or cesspools. The Board of Health which is responsible for individual disposal systems reports that there are no chronic septic system problem areas. When a public sewer is accessible, residents experiencing septic tank problems are required to tie into the sewer.

Septage Disposal - About five pumpers are currently licensed to pump and haul septage within Newton. There are no septage disposal facilities currently provided within the town; septage is reportedly hauled to neighboring towns for disposal. Based on an existing population of 18,000 served by septic tanks, an estimated 2,700,000 gallons of septage would be generated per year (7,500 gpd). However, this figure could be significantly increased if a large number of septic system failures occur (and consequently septic tanks are pumped more frequently).

On-Lot Sewage Disposal - The few scattered unsewered areas of Newton are largely unsuitable for subsurface disposal systems due to deposits of becrock and a high water table. Potential problems are likely in these areas due to the residential zoning density, 2 to 5 dwelling units per acre. This lot size reduces the possibility of finding a suitable soil condition for safely locating a septic tank and leaching field. If problems do occur, if there is not already a sewer line available, a viable solution would be to extend the sewer line to these locations. The policy should be continued of requiring residences experiencing septic tank problems to tie into the sewer lines. Water conservation measures should also be encouraged.

Surface and Groundwater Protection - Newton has a wetland floodplain zoning district which protects wetlands and the flood hazard areas along the Charles River. The ponds and/or lakes in Newton have been reportedly having varying degrees of pollution problems. Hammonds Pond suffers from urban runoff and algae growth; Bulloghs Pond can no longer even be used for skating due to the thick algal growth; and Silver Lake suffers from open dumping of refuse. Crystal Lake is reportedly clean and used for swimming and fishing. Consideration could be given to establishing watershed protection districts with buffer zones to monitor new developments in order to minimize the amount of impervious surfaces that influences urban runoff, to review the design of the site drainage system and to prevent open dumping of refuse.

Newton relies on the MDC for its water supply. There are no known areas with a high favorability for groundwater.

WALTHAM: EXISTING AND POTENTIAL PROBLEMS

Municipal Sewerage Facilities - The city has an extensive sewer system that serves about 95 percent of the population. Wastewater is discharged to the MDC-Charles River Valley sewer and treated at the MDC-Deer Island facility. A small section of Waltham's sewer system on Lake Street consists of sanitary sewers and storm drainage systems with common manholes. These particular common manholes were constructed so that one system was completely sealed off from the other. Common manholes were used to lower the installation and excavation costs. Leakage in the system has been identified by the presence of raw sewage in Chester Brook. Illegal sewer connections to the storm drains may also contribute to the problem. Waltham's wastewater consultant, C.E. Maguire, Inc., is presently designing a new sewer to replace the sanitary sewer in the common manhole area.

Overflows - There are two inverted siphons in the Waltham sewer system that have overflow facilities. These siphons are located on Farwell Street and Newton Street and cross under the Charles River. Overflows originate from the upstream and downstream chambers of each siphon during heavy wet-weather. Excess infiltration/inflow may be the major contributor. A regular maintenance program has significantly reduced the frequency of discharge to rain storms lasting several days. The facilities plan recommended that the Newton Street siphon be replaced by a connection to the South Charles relief sewer. The Farwell Street siphon is to remain and should have sufficient capacity to prevent overflows after Raytheon Company completes its water recycling project.

Industrial Discharges - The Exxon Co. has been issued an NPDES permit to discharge treated stormwater runoff to Stony Brook. An oil and grease separator is required.

The Shell Oil Co. is permitted to discharge stormwater runoff and small quantities of washwater to Beaver Brook following treatment. The treatment required is separation of the solids, oil and grease from the water.

Landfills - Until four years ago, the City of Waltham operated an incinerator and disposed of ash residue at landfill off Sawyer Road adjacent to the Charles River. According to town officials, the landfill has not encroached upon the river, and has not experienced a leachate problem. At the time of the site visit (Sept. 1976) there was no evidence of leachate seepage, although the adjacent Purgatory Cove exhibited nutrient enriched weed growth.

The facility has been covered with gravel and is presently used for the disposal of brush, stumps, catch basin cleanings, and road building debris.

To assess the presence or absence of impact, the adjacent waters should be sampled, with remedial measures taken if so indicated. The continued use of the facility should observe landfill regulations, with sealing and planting when capacity is reached.

Waltham presently disposes of refuse at a joint transfer station in Newton. Refuse is subsequently hauled to a private regional landfill in Amesbury.

Concerning future disposal, Waltham is a member of the 128 West Refuse Recovery Council which is seeking the implementation of a plan for a regional facility to meet long term disposal needs.

Failing Septic Systems - Approximately 5 percent of Waltham's population is served by septic tanks or cesspools. The Waltham Board of Health which is responsible for individual disposal systems reported that there are no specific problem areas. About 12 system failures per year are reported to them. Homes within 200 feet of a public sewer are obligated to connect to the sewer, if they are experiencing septic system problems.

Septage Disposal - Three pumpers are currently licensed to pump and haul septage within Waltham. The pumpers reportedly make their own arrangements for disposal of septage. Based on an existing population of 2,800 served by septic tanks, an estimated 430,000 gallons of septage would be generated per year (1,200 gpd). However, this figure could be significantly increased if a large number of septic system failures occur (and consequently septic tanks are pumped more frequently).

On-Lot Sewage Disposal - The few unsewered areas of Waltham are largely unsuitable for subsurface disposal systems due to deposits of bedrock, hardpan soils or a high water table. Potential problems are likely in these areas due to the residential zoning density, minimum lot sizes less than 20,000 square feet. These lot sizes reduce the possibility of finding suitable soils for safely locating septic tanks and leaching fields. However, Waltham's present plans are to extend the sewer lines to those remaining areas of town that are unsewered. Waltham's policy of requiring homes to connect to the sewer line when there are system failures will eliminate problems as they occur. Water conservation measures should also be encouraged.

Surface and Groundwater Protection - Waltham presently does not have any wetland or floodplain zoning district. Even though Waltham is largely developed, some areas of wetlands still remain. The Charles River and several small streams have no zoning protection and some areas are subject to flooding. Hardy Pond is severely degraded with excessive algal growth and sedimentation. The pond is attractive and would provide excellent recreation opportunities if upgraded. To protect its natural resources, Waltham could consider adopting a water resource protection district. Included in this district could be provisions for controlling future development to protect wetlands, areas subject to flooding, streambanks and the watershed and banks of Hardy Pond.

Waltham relies on the MDC for its water supply. There are no known areas with a high favorability for groundwater.

WATERTOWN: EXISTING AND POTENTIAL PROBLEMS

Municipal Sewerage Facilities - The town has an extensive sewerage system that is tributary to the MSD system. The entire town has sewer service with the exception of a country club and two residences. Wastewater is treated at the Deer Island facility.

Industrial Discharges - The Barry Division of Barry Wright Corporation has been issued a permit that allows the company to discharge uncontaminated cooling water to a storm drain that is tributary to the Charles River. The permit allows a discharge of 45,000 gpd at a temperature of 80°F.

Haartz-Mason, Inc. is permitted to discharge 124,000 gpd of uncontaminated cooling water to the Charles River. The maximum temperature allowed is 83°F. The company has also been issued a permit for a stormwater discharge.

The Quincy Market Cold Storage and Warehouse Co. is permitted to discharge 2,000 gpd of uncontaminated cooling water at 75°F to stormdrains tributary to the Charles River.

Landfills - The Town of Watertown formerly operated an incinerator and landfill off Grove Street, approximately 1,500 feet north of the Charles River. Drainage in the area is poorly integrated as a result of extensive filling and grading of the surrounding industrial area. Drainage of the site does, however, reach the Charles River via surface and subsurface pathways.

According to town officials the facility is no longer used except for the disposal of road building debris which is used as cover. Although no leachate problems are reported at the site, the Mass. DEQE has instructed that the facility be closed and sealed in accordance with state landfill regulations. Careful sealing and subsequent planting of the facility should ensure the absence of future problems at this site.

Presently, refuse is hauled from a transfer station at the landfill site to a private regional landfill in Amesbury. There are presently no plans concerning the future use of other disposal facilities.

Surface and Groundwater Protection - Except for some wetlands in the 52 acre Watertown Arsenal site, there are no significant wetlands in Watertown. The ultimate disposition of the Arsenal site should contain site development controls to prevent these wetlands valuable for open space, flood prevention, and wildlife habitat. Flood hazard areas are only along the Charles River and they are largely in MDC park use.

Sawins and Williams Pond are an important part of the Town's drainage system. They are natural buffers against uncontrolled costly storm drainage. East Watertown is in a watershed that drains into these two ponds prior to discharge through Sawins Brook into the Charles River. Consideration could be given to establishing watershed protection districts with buffer zones around the ponds and brook. This would serve to monitor new developments, in order to minimize the amount of impervious surfaces that influences urban runoff, to review the design of the site drainage system, and to prevent open dumping.

Watertown relies on the MDC for its water supply. There are no known areas with a high favorability for groundwater.

WELLESLEY: EXISTING AND POTENTIAL PROBLEMS

Municipal Sewerage Facilities - The town has an extensive sewerage system that serves about 90 percent of the population. Wastewater is discharged to the MSD system and treated at the Nut Island facility.

Landfills - The Town of Wellesley formerly operated an incinerator and ash landfill off Great Plain Ave on the Needham town line. Although the incinerator was closed in 1974, the landfill has remained open for the disposal of leaves, brush, and road building debris, etc. The site is bordered on 3 sides by wetlands which are drained by Great Fuller Brook. The Brook flows a distance of approximately two miles to the Charles River to the west.

Although town officials report no specific water quality impacts from the facility, several upgrading measures have recently been implemented. Included are sloping of banks, drainage improvements, and sand barrier to separate the facility from wetlands to the west and Fuller Brook to the northeast. The town also plans to properly seal the facility in accordance with state landfill regulations by the spring of 1978.

The site should be monitored to provide necessary information for the specification of appropriate closing and sealing measures.

Wellelsey presently disposes of refuse at a transfer station on the site. Refuse is subsequently hauled to a private regional landfill in Plainville.

Concerning future disposal, Wellesley is a member of the 128 West Refuse Recovery Council which is seeking implementation of plans for a regional facility to meet long term disposal needs.

Failing Septic Systems - Approximately 10 percent of Wellesley's population relies on septic tanks or cesspools for wastewater disposal. The Wellesley Board of Health, which is responsible for individual disposal systems reported that there are no chronic septic system problem areas within the town. A normal amount of isolated failures reportedly occur annually and are distributed throughout the areas served by septic systems.

Septage Disposal - Five pumpers are currently licensed to pump and haul septage within Wellesley. There are no septage disposal facilities, public or private, within the town. Septage pumpings from Wellesley are reportedly disposed of in an MSD manhole outside of the town. Based on an existing population of 2,700 served by septic tanks, an estimated 360,000 gallons of septage would be generated per year (1,000 gpd). However, this figure could be significantly increased if a large number of septic system failures occur (and consequently septic tanks are pumped more frequently).

On-Lot Sewage Disposal - There does not appear to be potential problems with failing septic systems. Wellesley's zoning in the few unsewered areas of town is compatible with the environmental capacity of the land to support development. With regular maintenance, inspection and pumping of existing systems and with correct installation of new systems, contamination should be kept to a minimum. Water conservation measures should also be encouraged.

Surface and Groundwater Protection - Wellesley has a floodplain zoning district that protects the 100 year floodplain of the Charles River. Land within this zone is restricted from development in accordance with specific regulations set forth in the Zoning By-Law. In addition, Wellesley has established watershed protection zoning for brooks and streams with the goal of preserving their open channels in a natural state. The width of the zones differ among the different brooks depending on the size of the watershed, the width of the brook and the potential of a brook for topping its banks during periods of high water. Land within this zone is restricted from new development. Some wetlands in Wellesley are protected by the Massachusetts Inland Wetland Restriction Act adopted by the State Department of Natural Resources in 1968. The remaining wetlands are unprotected except by the state Wetlands Protection Act to ensure that these wetlands remain undeveloped which does give authority to regulate development but only ensures that development is made in an environmentally sound manner.

Wellesley should consider adopting a wetland zoning district.

Major water quality degradation problems have not been reported for any of the ponds in Wellesley. To plan for the future, Wellesley could consider including the watersheds of the ponds in their watershed protection zoning district for brooks and streams.

Wellesley relies on seven gravel packed town wells for their water supply, with an emergency backup connection to the MDC system. The wells are located over two extensive areas with abundant groundwater, one in the western and one in the eastern section of town. Wellesley's aquifers are largely protected by their existing natural resources zoning districts. Those areas that are not could be included in an aquifer protection district. This district often includes provisions for limiting the amount of impervious surface to allow for adequate water percolation and restrictions for any development around well sites.

WESTON: EXISTING AND POTENTIAL PROBLEMS

Municipal Sewerage Facilities - The town does not have a municipal sewerage facility. However, the Weston Junior High School has a small, secondary treatment facility to treat the wastes from the school and a nearby bus garage. The facility was designed to treat an average flow of 8,000 gpd and began operation in 1969. Treatment consists of screening, comminution, aeration, clarification, sand filtration, and chlorination. The effluent is discharged to the ground via sand infiltration beds. An NPDES permit is not required. Flow and treatment efficiencies were unavailable. The grounds crew of the school is responsible for maintaining the facility.

Sludge - Excess sludge from the clarifier is discharged to an underground aerated holding tank. The sludge will be pumped from this tank as required and hauled to a disposal site. The operator of the treatment facility did not know where the sludge would be disposed of.

Non-Municipal Sewerage Facilities - Regis College has a small, primary treatment facility that was designed to treat about 7,000 gpd. The facility is currently treating about 7,600 gpd. Treatment consists of comminution, settling, sand filtration, and chlorination. The settling takes place in the upper compartment of a two-level clarigester. The lower compartment is used to digest the solids that accumulate in the upper compartment. The chlorinated effluent is pumped to sand infiltration beds for final disposal. Excess effluent can be used to sprinkle a grass area. Effluent characteristics were unavailable. The plant has been operating at capacity for some time and has minor problems with excessive grease from the dining hall and clogging of the comminutor.

Sludge - Solids from the upper compartment of the clarigester are digested in the lower compartment. Digested sludge is discharged to sand drying beds for dewatering once every three months. The dewatered sludge is hauled to the Weston landfill or to a nearby nursery.

Industrial Discharges - Massachusetts Broken Stone Co. has been issued a permit to discharge quarry water and the wastewater from the bituminous concrete dust control facility. A limit of 20 mg/l of total suspended solids was established for the discharge.

Landfills - The Town of Weston presently operates a landfill off Church Street near North Ave. The facility is west of, and drained by Stony Brook which flows south a distance of approximately one mile to the Stony Brook Reservoir which serves as part of the Cambridge water supply.

The site is reported to be 400 feet away from Stony Brook. Site grading directs drainage initially awar from the Brook to an area where infiltration to the groundwater system takes place. Cover material consists of sand or gravel, which, because of its permeability, is not adequate to prevent infiltration and leachate formation. The Mass. DEQE has reportedly instructed that an impermeable layer be applied between lifts.

Weston is awaiting DEQE approval of recently updated and revised plans. Some test drilling for groundwater determinations was conducted during plan revision, although it is uncertain whether water quality analyses were performed on samples. The only reported evidence of possible impact involves the 1972 closing of town wells along Stony Brook due to bacterial contamination. Although the landfill may have been responsible, the particular source of the problem was not identified.

Given the presence of an underlying aquifer and a downstream reservoir, operations at the Weston landfill must maintain the highest standards, and surface and groundwater monitoring should be routinely conducted to give early detection or impacts. Assuming approval of expansion to the west, the site is estimated to have remaining capacity for 7-8 years of operation. After capacity is reached, the site should be carefully closed and sealed in accordance with state landfill regulations.

Concerning future disposal, Weston is a member of the 128 West Refuse Recovery Council which is working toward the implementation of a plan for a regional facility to meet long disposal needs.

Failing Septic Systems - Weston is entirely served by septic tanks or cesspools except for Regis College, the junior high school, and the Cambridge School of Weston. The Board of Health is responsible for individual disposal systems. The only area of Weston experiencing chronic septic system problems is the densely developed center of town. The commercial establishments are currently served by a number of cesspools, septic tanks, and holding tanks. Two cesspools on either side of the Boston Post Road have been identified by the Weston Board of Health as sources of pollution. Three businesses in the downtown area discharge their wastewater to holding tanks which must be pumped on a regular basis. The causes of these malfunctioning disposal systems are reported to be due to poor soils, clay, peat, and ledge, to a high water table and to high density development. This area is situated in the Stony Brook Watershed, part of Cambridge's water supply. In 1964, the Weston Board of Health reported that the Brook running under the town common to the Stony Brook watershed was being contaminated by the malfunctioning disposal systems in the town center.

The town is presently addressing these pollution problems in the town center. A facilities plan has been prepared, recommending a small wastewater collection system to serve the problem areas. A detailed geohydrologic study is being conducted to determine the acceptability of several preliminary selected sites for a large-volume septic tank and subsurface disposal facility. If a suitable site is not available, the areas proposal to be sewered will probably connect to the MSD system. The plan also recommended that the town implement a septic system evaluation program.

Septage Disposal - Currently, five pumpers are licensed to pump and haul septage within Weston. The town has an existing contract with the MSD (expires September 13, 1979) that allows Weston's septage to be disposed of in MSD manholes in neighboring MSD communities. While the majority of Weston's septage is discharged to MSD facilities in Needham, some is also discharged to MSD facilities in Natick and Wellesley. The town is currently charged $1/capita/year for MSD septage disposal privileges, although this rate will be increased to $1.25 for FY 78. Based on reported pumpings in recent years, an estimated 1,400,000 gallons of septage are generated per year (3,800 gpd).

On-Lot Sewage Disposal - At the present time all of Weston relies on septic systems, although in the future areas in and around the town center are planned to be sewered. Weston presently does not have a detailed soil survey which would indicate the areas in town that would have severe limitations for septic systems due to hardpan, bedrock, or wetness. However, judging from the overall soil conditions of the surrounding towns and town reported reasons for existing failures, limitations could be possible. But, Weston relies largely on large lot zoning. This reduces the probability of potential problems, for the large lots allow an adequate area for finding suitable soils for wastewater disposal. A detailed soil survey of the town would assist in locating septic tanks and leaching fields safely. With proper location and with regular inspection and maintenance of the septic systems, contamination should be kept to a minimum. Those few areas of town that are zoned at a higher residential density and for business or limited industrial use are within or adjacent to the town center which is planned to be sewered. Water conservation measures should also be encouraged.

Surface and Groundwater Protection - Weston has a combined floodplain and wetland protection district for the purposes of flood prevention, preservation of the water table and recharge areas and the continuation of the natural flow pattern of water courses. Many of the wetlands are additionally protected, having been acquired by the conservation commission.

Part of an area of high groundwater favorability is located in Weston underlying Cherry Brook and Stony Brook. The recharge area is largely protected being part of the floodplain wetland district. A 100-150 unit condominium development is proposed to be located near Cherry Brook. Subsurface disposal system, monitored by Camp, Dresser & McKee, is being designed and located so as to not endanger the water quality of Cherry Brook or the aquifer.

Although Weston's zoning districts have been delineated with consideration of surface and groundwater protection, their wells have been polluted by runoff from the Massachusetts Turnpike. The generous application of de-icing salt has been identified as the cause of the pollution. Strong controls on salt application are critical at both the state and local level and should be enforced. Weston presently relies on the MDC for water. All efforts should be made to protect their groundwater supply from future pollution with the goal of eventually having drinkable town water again.

Chapter 4

Water Quality Management Options

CHAPTER 4 WATER QUALITY AND WASTEWATER MANAGEMENT OPTIONS FOR THE LOWER CHARLES RIVER BASIN

In this chapter, you will find:

A. Structural solutions with sewering and non-sewering concepts and an evaluation of structural options (with matrix).

B. Non-structural solutions - Land Development Controls and an evaluation of the non-structural options (with matrix).

C. An examination of the short and long-term solid waste management options (with matrix).

D. Recommendations on applying "best management practices" for stormwater runoff.

E. A brief discussion of present septage disposal practices in the basin (recommendations as to the available options for septage management of treatment to follow in a separate report).

INTRODUCTION

In response to the existing and potential sources of water pollution by community as discussed in the previous chapter, Chapter 4 presents appropriate structural and non-structural options to resolve or prevent such problems. With Massachusetts residents now paying up to $200,000 a day to clean up their water it is evident that some measures to achieve water quality will be costly. Others will be difficult to achieve politically, requiring new laws or changes to existing laws. It is essential that each community consider the solution options as potential parts of an overall management system. The solutions should be chosen in light of the community's growth and development goals as well as its need to correct or prevent water quality problems.

Solutions to existing and potential water pollution can be grouped into two major categories.

- Non-structural - Local, regional, state and federal management mechanisms regulating those activities which generate wastewater;

- Structural - Systems and technologies concerned with the conveyance, treatment and disposal of wastewater.

From an implementation perspective, these two categories differ in their emphasis on preventing or correcting water quality problems. On one end, water quality management and some pollution control can be achieved to a great extent via the relatively inexpensive institution of regulatory measures, primarily preventive in nature. However, because of overlapping jurisdictions, varying interpretations of complex laws and the strong New England tradition of local autonomy, this type of water quality management program is very difficult to achieve.

Wastewater treatment systems are technologies for water pollution control primarily corrective in nature, and moderately easy to implement. However, they can be very costly, even though construction costs are partially subsidized by the state and federal governments.

A matrix summarizing the structural options for communities in the Lower Charles River Basin is presented at the end of part A of this chapter. Equally important non-structural solutions, primarily land development, are discussed and summarized for all the communities of this basin.

Rather than relying solely on such discussions and matrices, however, the reader should refer back to the description of overall basin and community-specific problems in Chapter 3 for the background and context within which various options are ranked. Additionally, the more complete discussion of alternative solutions in Appendix C - Definitions of Solutions - should be consulted periodically. As a general rule, most of the structural and non-structural options described in this regional- or basin- scale report will need a considerable amount of fitting or tailoring to the local or site-scale level of specificity before they can be implemented.

A. STRUCTURAL SOLUTIONS - WASTEWATER DISPOSAL

Sewerage employs the so-called structural solutions to alleviate pollution problems where other types of solutions have been determined to be impractical or not cost-effective. Such a situation usually arises where septic systems are constructed in insufficiently porous soils or lack a proper maintenance program. When the soil becomes incapable of absorbing more waste, the raw effluent flows to the soil's surface and runs overland.

Structural solutions generally imply the construction of sewers, treatment facilities and ancillary works for the collection, conveyance, treatment and ultimate disposal of wastewater. However, construction or reconstruction of a septic system may also be regarded as a structural solution of wastewater disposal problems. In order to assess present and future needs for sewering or non-sewering solutions necessary for the control of existing and potential water quality problems, two wastewater management concepts were developed. Thus residents of this basin are presented with two conceptual schemes for handling wastewater flows to assist them in assessing different alternatives available for wastewater disposal.

Sewerage - Lincoln and Weston are the only two communities in this basin with no municipal sewers. All other communities are extensively sewered, with sewered populations ranging from 80 to 100 percent of total populations. These communities are served by the Metropolitan Sewerage District (MSD) and wastewater is conveyed to Boston Harbor treatment facilities for primary treatment before discharging into the Atlantic Ocean. Most of these communities are not faced with the issue of whether to sewer or not to sewer their community. However, there are certain areas where decisions will have to be made by 1995 as to the applicability of sewering or non-sewering options. This is discussed later in this chapter under the two concepts.

Sub-Surface Disposal Systems - Besides Lincoln and Weston which rely completely on subsurface disposal systems, significant percentages (15 percent or more) of residents in Lexington, Natick, Needham and Newton still use subsurface disposal methods for their wastewater. Most of these systems are performing satisfactorily, some with slight to moderate problems due to lack of proper maintenance. Areas with chronic septic system problems have been reported in the towns of Natick and Weston and and were discussed in more detail in Chapter 3 and in the concepts later in this chapter.

It is important to point out here that technological alternatives with regard to wastewater disposal and treatment are discussed in Appendix C . Various solutions involving conventional sewerage systems and innovative technology without sewer construction are presented to provide the reader with a background in selecting different options. More information on subsurface disposal systems, their operation and maintenance, and cost estimates would appear in MAPC's "Hydro-Logic" Handbook and Regional Septage Management Report both to be published in December 1977.

Following is a description of the methodology used in delineating potential sewer service areas. Except where there are existing septic system problems, all other potential sewer service areas are delineated as being likely to be sewered by 1995 if developed according to existing zoning or if severe septic system problems were encountered. The decision is, however, up to the discretion of each community as and when such a need is recognized.

Methodology for Delineating Sewer Service Areas - Future sewer service areas (those currently not sewered nor programmed for sewers in the immediate future) have been developed taking into account the following:

- Existing and programmed service areas (See Figure 5).
- Existing development and suitability for future development as described in the MAPC DeFacto Pattern.
- Development capabilities of the land as described in the MAPC Environmental Pattern.
- Existing problem areas identified by local officials and residents during MAPC-sponsored issue identification meetings and by correspondence between MAPC staff and local boards of health and sanitarians.
- Existing areas of failing septic systems identified by MAPC consultants Camp, Dresser and McKee during interviews with local officials.

Three criteria were used as the basis for delineating potential sewer service areas.

1. Immediate (or near future) extensions of an existing sewer system to serve existing development in the identified problem areas. In communities having no existing sewer system, the initial service areas were based on identified problem areas.

2. Extensions of an existing sewer system to serve existing, unsewered development or extensions of criterion 1 systems to serve existing development in areas adjacent to the identified problem areas.

3. Extensions to serve projected development in areas of prime and moderate suitability for development or continuation of criteria 1 and 2 systems identified above into areas with prime and moderate development suitability as defined in the DeFacto Pattern.

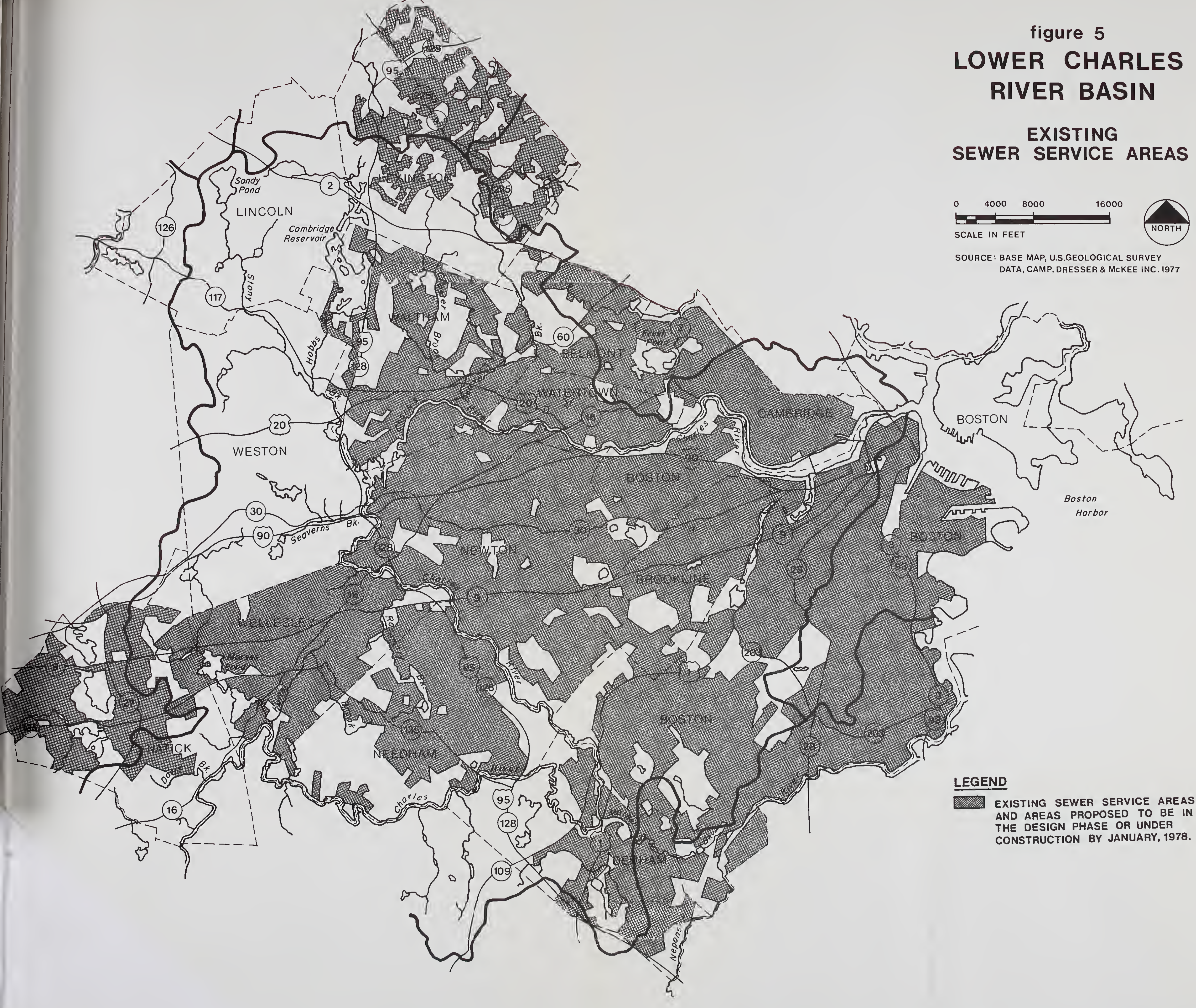
Potential sewer service areas were mapped using a series of overlays. Maps showing existing sewer service areas were overlayed on maps showing existing land use. Areas conforming to criteria 1 and 2 were then traced. This tracing was then overlaid on the Development Suitability map prepared in conjunction with the DeFacto Pattern. Areas conforming to criterion 3 were then traced onto the overlay. This completed trace/overlay essentially delineates the maximum potential sewer service area which might be considered under any circumstances of future development through 1995.

The completed tracing described above was then overlaid on the map, "Conflicts between Existing Zoning and the Environmental Pattern". Areas previously identified and traced out according to criterion 3 were then eliminated, if a change in current zoning might preclude the likelihood of future development causing problems. However, as an exception to this rule,

figure 5

LOWER CHARLES RIVER BASIN

EXISTING SEWER SERVICE AREAS



SOURCE: BASE MAP, U.S.GEOLOGICAL SURVEY
DATA, CAMP, DRESSER & McKEE INC. 1977

LEGEND

▨ EXISTING SEWER SERVICE AREAS, AND AREAS PROPOSED TO BE IN THE DESIGN PHASE OR UNDER CONSTRUCTION BY JANUARY, 1978.

industrially zoned areas which were in conflict with the Environmental Pattern but which were in close proximity to the existing sewer system were also shown on the Potential Sewer Service map. (See Figure 6.) The remaining areas were than generalized in order to determine waste flows and loads.

The existing problem areas as described in the methodology are those areas which will probably require more than reconstruction or upgrading and maintenance of existing septic systems. Conceptual schemes presented on Figures 7 and 8 show different arrangements of wastewater management in the basin using sewering and non-sewering alternatives. The two concepts are as follows:

Concept I	Sewer Service Area Expansion
Concept II	Maximum Reliance on Non-Sewering Options

The sewer service areas as shown in the concepts are in addition to planned expansion envisaged under 201 facilities plans for various communities. The concepts are described in more detail later in this chapter.

Waste Flow Generation (wastewater quantity) - After potential sewer service areas for each community were developed, wastewater flows from each area were generated. The wastewater flows consist of residential, commercial, industrial and infiltration flows as a function of the specific land uses found in each service area. For residential areas, waste flow generation rates of 60-85 GPCD were assumed. A detailed methodology of waste flow projection for 1995 and projected wastewater flows for residential and other source is described in Appendix B.

Wasteload Projection (wastewater quality) - Wasteload projections were computed to determine peak and average daily pollution loads in terms of BOD and suspended solids imposed on the treatment facility. The wasteload projections for each area and the methodology used are also given in Appendix B.

The wasteload and wasteflow projections presented in Appendix B (available on request) quantify pollution loads which will be handled by Boston Harbor treatment facilities. However, these figures do not exceed the peak design flow criteria established by the EMMA study for upgrading and/or expanding Boston Harbor facilities. Hence no additional costs other than what is already estimated under the EMMA plan would be incurred. The EMMA plan is discussed briefly in this chapter.

Wastewater Treatment Efficiencies - As a general rule, secondary and advanced (tertiary) treatment plants are assumed to provide the following BOD and Suspended Solids removals:

Secondary Treatment	85%
Advanced Treatment	95%

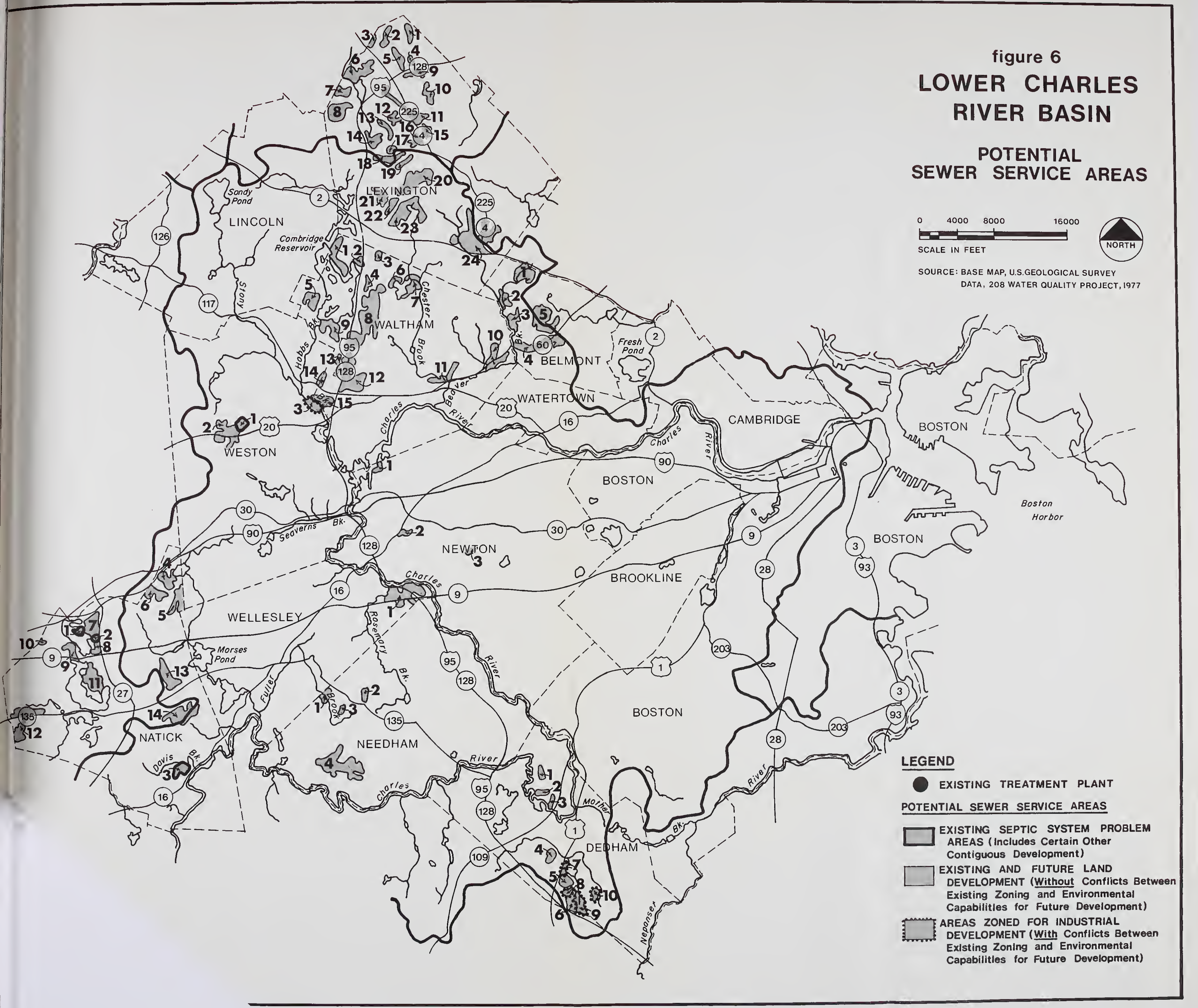


figure 6
LOWER CHARLES RIVER BASIN
POTENTIAL SEWER SERVICE AREAS

SOURCE: BASE MAP, U.S.GEOLOGICAL SURVEY
DATA, 208 WATER QUALITY PROJECT, 1977

LEGEND

● EXISTING TREATMENT PLANT

POTENTIAL SEWER SERVICE AREAS

▨ EXISTING SEPTIC SYSTEM PROBLEM AREAS (Includes Certain Other Contiguous Development)

▨ EXISTING AND FUTURE LAND DEVELOPMENT (Without Conflicts Between Existing Zoning and Environmental Capabilities for Future Development)

▨ AREAS ZONED FOR INDUSTRIAL DEVELOPMENT (With Conflicts Between Existing Zoning and Environmental Capabilities for Future Development)

It should be noted that secondary treatment is the minimum treatment level allowed by law for wastewater discharged into the ocean or into streams which are classified as effluent limited. Presently Deer Island and Nut Island treatment facilities provide primary treatment before discharging sewage into Boston Harbor.

For water quality limited streams, removal of nutrients (nitrogen and phosphorous) is essential and advanced treatment is employed. Charles River is a water quality limited stream. Package plants are considered to provide an effluent of quality not less than that from a secondary treatment plant. However, no package plant would discharge into any stream in this basin as presented in this report.

Wastewater Management Concepts - The following two conceptual configurations are presented in order to examine the merits (or disadvantages) of various possibilities proposed in this and previous studies. Before discussing them, it should be pointed out that these concepts have been developed, keeping in mind the existing pattern of wastewater disposal as well as future possibilities for inter-basin and regional cooperation towards wastewater management.

Concept I - Sewer Service Area Expansion

Potential sewer service areas were identified for nine of the fourteen communities in the Lower Charles Basin. Since all of these communities except Weston are extensively sewered and are in the tributary area of the Metropolitan Sewerage District, identified potential sewer service areas may be connected to the MSD system by 1995. This would be in conformity with the existing and projected future practice of wastewater management and treatment in the basin. (See Figure 7)

The Town of Weston has already engaged the consultants to study its wastewater treatment needs. The existing problem area as shown on Figure 6 would probably be served by a communal septic system with minimal sewering. However, the determination of a suitable site or sites is still being studied. The City of Waltham has undertaken a project for the improvements to the existing sanitary sewerage system. The trunk sewers and relief sewers when constructed would have enough capacity to handle 1995 flows.

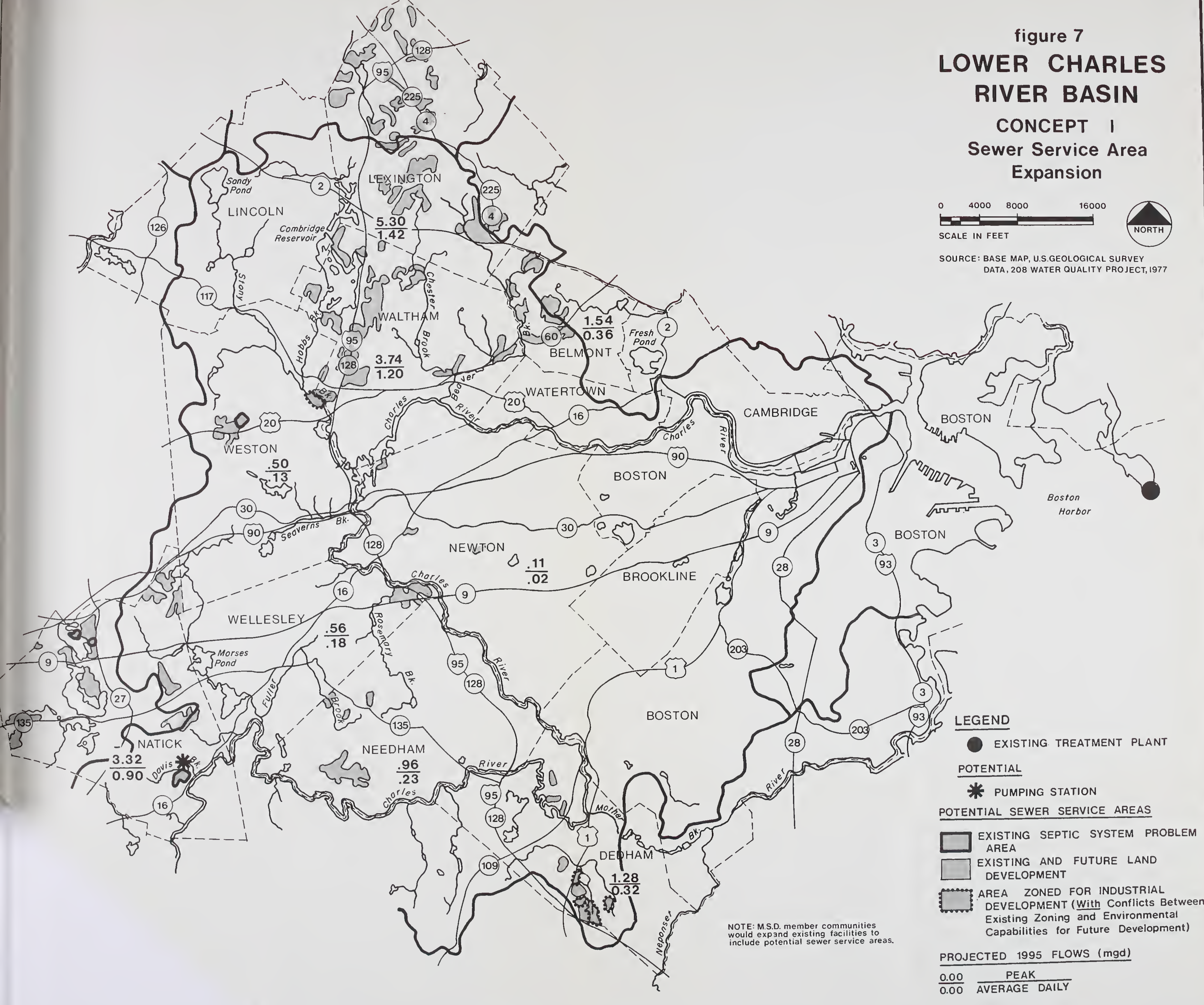
The largest wastewater flow contribution would come from four communities, namely Belmont, Lexington, Waltham and Natick. The total projected 1995 flows from these communities would be about 4 mgd average flow and 14 mgd peak flow. The flow contributions from the rest of the communities would be rather insignificant in terms of operation and maintenance costs. (See Appendix B, available on request.)

figure 7

LOWER CHARLES RIVER BASIN

CONCEPT I

Sewer Service Area Expansion



SOURCE: BASE MAP, U.S.GEOLOGICAL SURVEY
DATA, 208 WATER QUALITY PROJECT, 1977

NOTE: M.S.D. member communities would expand existing facilities to include potential sewer service areas.

LEGEND

● EXISTING TREATMENT PLANT

POTENTIAL

✱ PUMPING STATION

POTENTIAL SEWER SERVICE AREAS

▨ EXISTING SEPTIC SYSTEM PROBLEM AREA

▨ EXISTING AND FUTURE LAND DEVELOPMENT

▨ AREA ZONED FOR INDUSTRIAL DEVELOPMENT (With Conflicts Between Existing Zoning and Environmental Capabilities for Future Development)

PROJECTED 1995 FLOWS (mgd)

0.00 PEAK
0.00 AVERAGE DAILY

In Natick most of the identified potential sewer service areas can be connected to the MSD system with relative ease. But, one existing problem area in South Natick being at a lower elevation would need a collection point and a pumping station to pump collected wastewater into the MSD trunk sewer. A package plant could be considered as an alternative to the pumping station but the cost-effectiveness of the two options should be evaluated by the town before making a decision.

Concept II - Maximum Reliance on Non-Sewering Options

Under this concept, most of the areas identified as potential sewer service areas (Figure 6) would not be sewered, but a strong and effective maintenance program for subsurface disposal systems would be formulated by individual communities to prevent future problems. There are, however, certain areas which lie within the existing sewer service area and hence should be considered more appropriate for sewering than reconstruction and/or maintenance of subsurface disposal systems if problems develop in the future. Areas where non-sewering options can be applied are shown on Figure 8 .

Existing septic system problems have been identified only in two communities of this basin. In Natick low lying areas along Eliot Street in southern Natick adjacent to the Charles River and along Perry and Evergreen Roads on the eastern shore of Lake Cochituate are reported to be experiencing chronic problems with septic systems. Since these areas are partly located in soils which are unsuitable for subsurface disposal and are very close to existing sewer systems, it would be logical to extend sewers to these three small areas by 1995 if problems persist. As mentioned earlier under Concept I, a pumping station would be needed in southern Natick if it were to be connected to the town sewer system. Construction of a package treatment plant with sand infiltration beds would eliminate the need for a pumping station but associated capital and O & M costs may not be cost effective in the long run. In Weston the only area experiencing chronic septic system problems is the densely developed center of town. A preliminary report by the town's consultants has recommended the construction of a small wastewater collection system to initially serve the center of town and to ultimately serve municipal buildings near the town center. The consultants are conducting a geohydrologic study to determine a suitable site for subsurface disposal systems. (We were recently informed by the consultants that no single site was available for a subsurface disposal system of 60,000 gallons capacity. They are now working on finding different combinations of sites in order to accommodate the desired capacity of subsurface disposal system.)

Costs for Future Treatment

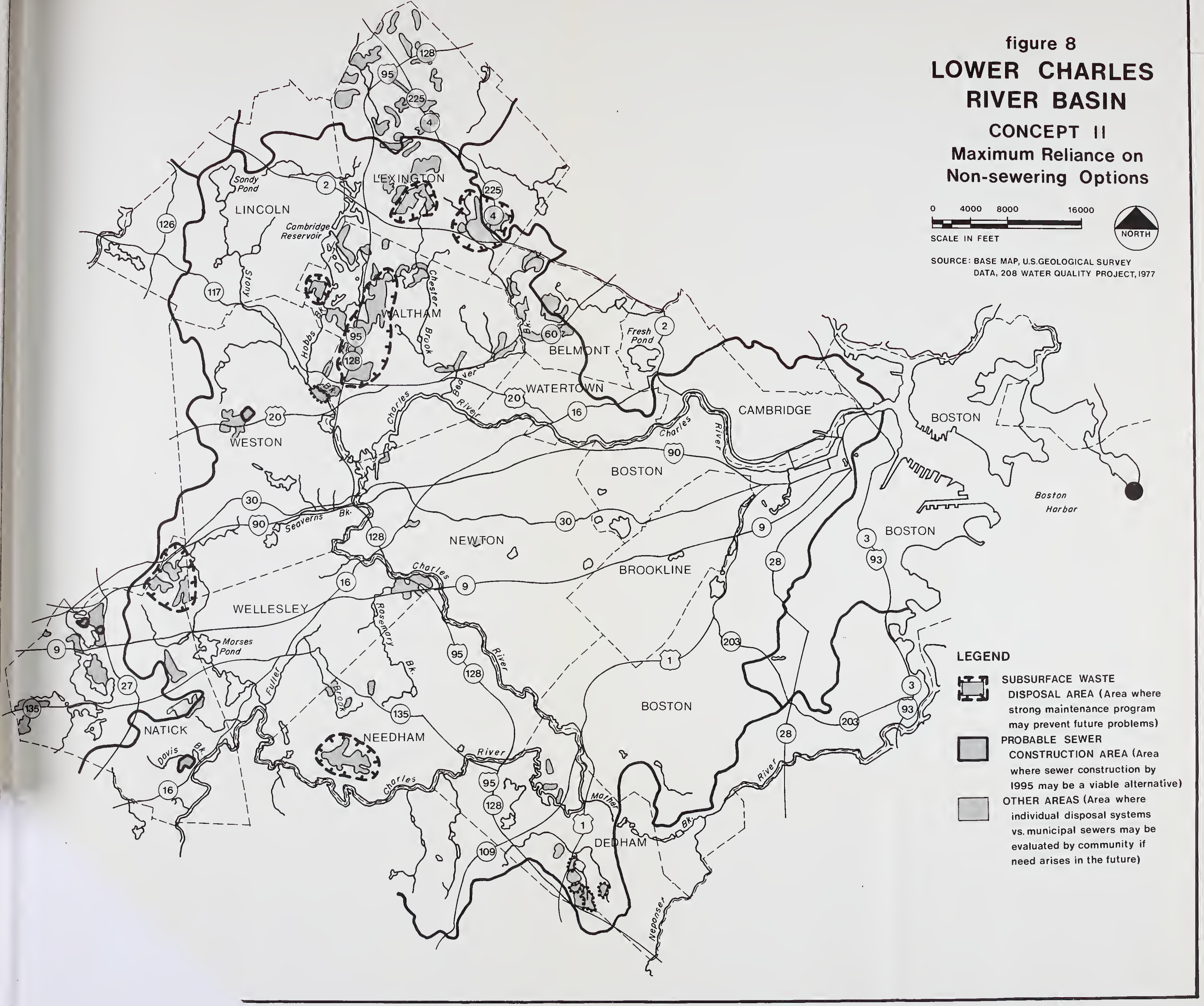
No new trunk sewers or interceptors would be needed under the two concepts. To estimate costs for collector sewers, it would

figure 8

LOWER CHARLES RIVER BASIN

CONCEPT II

Maximum Reliance on Non-sewering Options



SOURCE: BASE MAP, U.S.GEOLOGICAL SURVEY
DATA, 208 WATER QUALITY PROJECT, 1977

require an in-depth study of each town's sewer system, its present hydraulic capacity and future needs. This is beyond the scope of this study and it is suggested that an engineering study may be initiated by a particular community if such a need is realized in future. No immediate need for sewering is anticipated beyond the on-going projects in some communities. However, three small areas in Natick and one small area in Weston have been identified as problem areas. The town of Weston has a facilities plan that addressed the pollution problems in Weston center and recommended a small sewerage system with subsurface disposal. Final cost estimates would be prepared by the consultants after a suitable site is selected for subsurface disposal.

In Natick, septic system problems in the three areas mentioned earlier are corrected promptly by the Board of Health. Under the present practice of inspection and maintenance, sewers would not be immediately needed. However, if the failing septic system problems continue and the areas become heavily developed, these areas should be considered for sewering in the future. In case the town were to decide sewering south Natick area, either a pumping station to pump collected wastewater into the town system or a package treatment plant would be needed. The following approximate costs of the two systems are presented for comparison.

Peak Flow (1995) = 68,000 gallons/day
Average Flow (1995) = 10,000 gallons/day

A. Package Treatment Plant with sand infiltration beds:

Capital Cost = $310,000 (March '77 - ENR index 2500)
Annual Operation and Maintenance Cost = $18,000

B. Pumping Station

Capital Cost = $100,000 (High)
Annual Operation and Maintenance = $10,000

In both alternative A and B the cost of local sewers is not included. It can, however, be seen that a package treatment plant would entail higher capital and O & M costs than a pumping station, but connection to MDC systems would also slightly increase user charges for the town. It is emphasized once again that it is up to the town to decide for the sewering option only if subsurface disposal problems warrant such action in the future.

All MSD served communities would be affected by the EMMA recommended modifications, upgrading and/or expanding the MSD system. The present user charges, as well as principal and interest (P & I) payments being paid by various communities to MDC would be significantly altered after the EMMA recommendations are implemented. The U.S. Environmental Protection Agency is conducting an Environmental Impact Statement (EIS) study on the upgrading of the MDC's wastewater treatment system. The Draft EIS is expected to be published by December 1977. The findings of EIS would be discussed in MAPC's Areawide Plan to be published early in 1978.

Eastern Massachusetts Metropolitan Area (EMMA) Wastewater Management Study

The EMMA study was initiated in 1971 and was conducted jointly by the Metropolitan District Commission and the U.S. Army Corps of Engineers, in cooperation with several other agencies. The major purpose of the study was to assess the need for upgrading or replacing components of the Metropolitan Sewerage District facilities since most of these facilities had reached their design capacities.

The study was managed by a Technical Subcommittee on Boston Harbor and included representatives of the U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, Massachusetts Department of Environmental Quality Engineering, Massachusetts Office of State Planning, Massachusetts Division of Water Pollution Control and the Metropolitan Area Planning Council. Metcalf & Eddy, Inc. was the major consultant on this project. To seek active participation by the public, a Citizens Advisory Committee (CAC) was instituted to coordinate and assist in such activities.

The study consists of 23 volumes of technical data and recommendations for wastewater treatment in Metropolitan Boston. The major recommendations of the study included the following:

1. Boston Harbor: The Deer Island Treatment Plant would serve three more communities than at present, and would be upgraded to provide secondary treatment for an average flow of 400 mgd by the year 2000. The Nut Island Treatment Pland would serve eight fewer communities than at present plus part of Dover. It would be upgraded and expanded to handle an average of 130 mgd by the year 2000. The sludge from both these plants would be incinerated at Deer Island incorporating a waste heat recovery system. Combined sewer overflows would be regulated to capture small overflows and treat large flows prior to discharge. The major projects relating to the regulation of combined sewer overflows are located along Dorchester Bay, the Charles River, the Neponset River and the inner Harbor following a decentralized approach to combined sewer overflow regulation. The major overflows have been described in Chapter 3 of this report.

2. Neponset River: An advanced treatment facility with a 25 mgd capacity to be located in the Canton-Norwood area. This would reduce the flow to the Nut Island Pland and retain reclaimed wastewater to augment low flows in the summer months.

3. Charles River: An advanced treatment facility with a 31 mgd capacity to be located in the middle reach of the river. It would also reduce flows to Nut Island and discharge reclaimed wastewater to Charles River for flow augmentation.

The construction program necessary to build these facilities is expected to cost approximately $855 million at 1975 prices (Engineering New-Record Index 2200). Operating costs are expected to increase from $8.3 million in 1974 to $29.5 million in 2000. For more detailed information, the reader is referred to EMMA Study reports, copies of which are available at various agencies mentioned earlier. The cost breakdown for major projects with completion dates under the EMMA recommended plan is shown on Table 4-1 .

Although construction priorities for various projects have been established through extensive negotiations with EPA, certain issues are still unresolved. The most prominent issue is whether the requirement of secondary treatment of wastewater discharged to the ocean is both cost effective and environmentally beneficial. Other major issues include when and how to expand the Deer Island and Nut Island Treatment facilities, whether satellite treatment is cost-effective and where to locate such treatment facilities along the Charles and Neponset Rivers. Some of the communities to be served by the satellite treatment plants are opposed to the construction in their neighborhoods due to various reasons.

Some of these issues are being addressed in EPA's Environmental Impact Statement, the draft of which is expected to be published shortly. A bill banning any fill at Nut Island was passed by the Massachusetts Legislature and signed by Governor Dukakis on June 14, 1977. This means expansion at Nut Island Treatment facility would be precluded from various alternatives that are being studied. Other alternatives being studied by EPA include the following:

1. Primary and secondary treatment for both the northern and southern service areas at Deer Island (with and without satellites).

It should be noted that if satellite treatment plants were built, all of the harbor facilities could be located on Deer Island without fill. This is contingent on the removal of the Deer Island House of Correction (Hill Prison). However, a treatment plant that would occupy virtually all of the acreage on Deer Island could have other environmental impacts, such as removal of the drumlin. If the prison facilities were to remain on Deer Island and no satellite treatment plants were constructed some fill would be required at Deer Island.

2. Primary and secondary for the northern service area at Deer Island. Primary and secondary for the

Table 4-1

COSTS AND COMPLETION DATES FOR MAJOR PROJECTS

Project	Completion Date	Cost, millions of $[1]
1. Elimination of sludge discharges into the Harbor from the Deer Island and Nut Island treatment plants.	1980	$ 26
2. Combined sewer overflow abatement in Dorchester Bay.	1981	77
3. Nut Island primary expansion and addition of secondary treatment.	1984	137
4. Deer Island primary expansion and addition of secondary treatment.	1984	192
5. Additional facilities for secondary sludge management.	1984	28
6. Satellite treatment plants discharging to the middle Charles and upper Neponset Rivers, (or transport to and further expansion of Nut Island Treatment Plant.[2]	1984	91
7. Combined sewer overflow abatement in the Charles River (Back Bay Fens and Muddy River).	1983	84
8. Combined sewer overflow abatement in the Neponset River.	1983	23
9. Combined sewer overflow abatement in the Inner Harbor.	1986	86
10. Others: Interceptors and pumping stations	1975-2000	111
Total		$855

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[1] Costs shown are in millions of dollars based on January 1975 (ENR 2200) prices and include engineering and contingencies.

[2] Costs are given for the former case.

southern service area at Squantum Point (former Naval Air Station) (with or without satellites).

3. Primary and secondary at Deer Island for the northern service area and primary and secondary for the southern service area at Broad Meadows, Quincy (with and without satellites).

The questions of outfall location and sludge disposal are also being addressed in the study. EPA has been holding workshops to inform the public and to seek their input towards the development of appropriate sites for the two satellite treatments mentioned before.

For the Mid-Charles Satellite Treatment, EPA spent a great deal of time in evaluating the water quality modelling that was done on the Charles River as part of the EMMA study. The results obtained from the improved model indicated that a discharge from a satellite plant at the Cochrane Dam, (as proposed in EMMA), will not meet water quality standards. However, our additional water quality modelling does indicate that a discharge above the South Natick Dam would meet water quality standards.

The location of the satellite treatment plant is being studied by the Site Evaluation Committee.

Site evaluation work for the Neponset River Satellite Treatment Plant has narrowed down numerous potential sites to only three. These sites are located near the Star Market Warehouse and the Norwood Arena.

Although a water quality model has not been developed for the Neponset River similar to the Charles, an ongoing water quality study to determine possible impacts on the Neponset River from a satellite treatment plant is being conducted. Particular attention is being given to impacts on water supply wells in the vicinity of the Charles and the Neponset Rivers as well as an analysis of possible virus problems as a result of the introduction of effluent into the river.

Projects under the MDC's recommended plan which do not require an Environmental Impact Statement (EIS) are reviewed by MAPC as part of A-95 reviews and as being the 208 agency for the metropolitan area. For projects which are being addressed by the EIS, MAPC's judgement would await the outputs of the formulation of EIS by the U.S. Environmental Protection Agency.

As mentioned earlier, the Draft EIS would be discussed in MAPC's Areawide Plan due early in 1978.

Facilities Planning - Each of the wastewater management options discussed in this chapter must be considered in light of existing facilities and plans in each particular town. Twelve communities in the basin currently have sewerage facilities and many of these communities are planning to upgrade and/or expand these services. This section summarizes the status of current wastewater facility plans and programs in the basin.

Facility planning, under Section 201 of Public Law 92-500, was designed to ensure the orderly development of plans and the timely submission of applications for funding of wastewater treatment facilities. A community wishing to receive federal and state funding for sewerage facilities construction must prepare a study called a facilities plan, Step 1 of the 201-planning process. This study is a detailed survey of existing problems and an analysis of possible solutions. In addition to the basic engineering considerations, facility plans must investigate all potential solutions at local and regional levels. This includes a cost-effectiveness comparison, an environmental assessment of each alternative, and a public participation program to solicit citizen input. Communities with existing sewerage systems are required to submit an infiltration/inflow survey to determine where renovation is needed and to ascertain how the extraneous flows can be eliminated. Following this phase of the 201-planning process, a community must prepare the detailed plans and specifications for the proposed facility. This Step 2 study also includes a cost estimate. Step 3 of the 201-process is the actual construction of the facility. (A flow chart of the 201-planning process can be found in Appendix B of this report, published separately and available upon request.)

EPA and the state evaluate the facility plans to determine the project's eligibility for funding. Eligible projects must be publicly-owned and operated, the most cost-effective alternative and capable of meeting effluent limitations as required by the Massachusetts Division of Water Pollution Control. The order of funding for eligible projects is determined by a priority list developed by the state. (Persons interested in a detailed description of the priority list should contact the Mass. Division of Water Pollution Control.) The priority list is based on the type of project and the project's affect on certain uses (i.e., water supply, health, wildlife, recreation). Each step of the process receives a priority number and is funded separately. Projects with lower priority have been placed on an extended priority list. The projects on this list will receive funding after those projects on the high priority list are funded. Current facilities planning the Lower Charles Basin is outlined below.

Belmont - There is no current facilities plan for this town.

Boston - The separation of combined sewers has been started in four Boston Redevelopment Authority (BRA) urban renewal areas. These projects have been halted because of lack of funding. A description of the projects is given below:

1. South End urban renewal area - The combined sewer separation in this area is about 20% complete. The remaining work will be completed when funding is available. A major part of this project involves the construction of the Union Park Street Pollution Abatement and Flood Control Facility. This facility is designed to provide screening, skimming, sedimentation and chlorination for stormwater. The first phase of construction of the facility has been completed and consists of the pumping equipment and the flood control facilities. The design of the treatment facilities awaits a Step 2 grant approval. The goal of this project is to reduce the pollution in Boston Harbor and the Roxbury Canal, and to alleviate some flooding problems in the area.

2. Charlestown urban renewal area - The separation of combined sewers in this area is almost finished. Several combined overflows were eliminated during construction in this area. Some of the funds used in this project came from the Dept. of Housing and Urban Development. A Step 3 grant application is pending for the remainder of the work.

3. South Cove urban renewal area - Separation of combined sewers in this area is about 66% complete. A Step 3 grant was denied in 1976 by EPA. A Step 3 application was resubmitted, but BRA officials are seeking alternate sources of funding.

4. Downtown Waterfront urban renewal area - The separation of combined sewers in this area is nearly 90% complete. Eight combined sewer overflows have been eliminated. Although a Step 3 grant request was denied by EPA, other sources of funding are under investigation by the BRA.

In addition to the BRA urban renewal projects, the city of Boston has begun to design the replacement sewers for the East Side Interceptor and the Main Interceptor. This project is a result of a 201 facilities plan prepared by Camp, Dresser & McKee in 1976.

Brookline - The town has no current facilities plan. There are, however, plans to clean the Brookline Sewer and institute a sewer inspection program.

Cambridge - The city's wastewater consultant, LE Maguire, Inc., recommended in a 1968 report that Cambridge begin a five-phase combined sewer separation program. To date, the first two phases have been completed. Phase I consisted of separating the combined sewers in the Pearl Street area. Phase II separation took place in two areas: near Rindge Avenue and in an area west of Central Square. Phase III is now under construction and is located in East Cambridge, north of Binney Street. Phases IV and V have not been started. Phase IV will separate the combined sewers that are tributary to the Lowell Street overflow. This is generally in the area west of Aberdeen Avenue. Phase V is located in the area between Massachusetts Avenue, Concord Avenue, and Upland Road. The design of this project has not been started. The purpose of these separation projects is to reduce or eliminate the combined sewer overflows to the Charles River and Alewife Brook, and to reduce the flows to the MDC relief facilities to within their 5-year storm capacity.

Dedham - There is no current facilities plan for this town.

Lexington - The town has submitted a grant application for Step 2 design of two collection system extensions, as recommended by Whitman and Howard in a 1977 facilities plan.

Lincoln - There is no current facilities plan for this town.

Natick - There is no current facilities plan for this town.

Needham - There is no current facilities plan for this town.

Newton - The city has submitted a Step 1 application for a 201 facilities plan. Preliminary plans include the construction of relief for the South Side Sewer to prevent surcharging. Coffin and Richardson is the city's wastewater consultant.

Waltham - The city has received an EPA construction grant of $3,296,000 for replacement of four pumping stations and attendant force mains. Over 10 miles of replacement and relief sewers will also be constructed as a part of the project. Four overflows to the Charles River and Chester Brook will be eliminated. C.E. Maguire Inc. is the city's wastewater consultant.

Watertown - The town has submitted a Step 1 application for facilities planning. The purpose is to investigate the facilities needed for relief in the Watertown Square and Arsenal Street area. This project should eliminate periodic overflows to public and private property.

Wellesley - The town is engaged in Steps 1 and 2 of facilities planning for relief facilities. The design of these facilities is now in progress.

Weston - The town's wastewater consultant, Haley and Ward, Inc., recommended in a 1971 facilities plan that Weston construct a collection system to serve the center of town. Wastewater would be pumped to Waltham where it would enter the MSD system. This plan was approved by the townspeople in 1971, but a moratorium on connections to the MSD prevented any construction. When funds were available in spring of 1976, the project was reactivated, but a new consultant was engaged to investigate alternatives. Camp, Dresser & McKee recommended in a 1977 preliminary report that Weston construct a local collection system with subsurface disposal. At this time, Camp, Dresser & McKee is investigating sites suitable for the subsurface diposal of 60,000 gpd.

The Cost of Other Structural Options - Reconstruction of individual septic tank systems, installation of communal septic systems and construction of package plants have been identified as potential solutions to wastewater disposal problems in communities of the basin in the summary matrix. This section (Table 4-2) presents cost comparisons of three alternatives. Although costs and underlying assumptions are considered to be reasonable estimates, no attempt was made to apply these solutions and costs to particular problem areas.

The following conditions were assumed in estimating costs:

- wastewater is generated at the rate of 80 gallons/person/day
- the average household size in the metropolitan Boston area is 4.5 persons (liberal figure used for this estimate only)
- the topography is relatively flat, and thus no pumping would be necessary
- land is available for reconstruction; land costs are not included for communal leaching fields or package plant sites
- septic tanks would be pumped once every two years*

The following unit prices were used in determining cost estimates:

4" house connectors in place	$5.00 L.F.
Pipe to distribution box	6.00 L.F.
Pipe (perforated) in leaching field	2.00 L.F.
Excavation	3.00 L.F.
1,000 gallon septic tank	200.00 EA.
15,000 gallon septic tank	6000.00 EA.
Screened gravel	6.00 C.Y.
Distribution box	50.00 EA.
Sewer	6.50 L.F.
Manholes	600.00 EA.
Package pland and sand infiltration bed (in place) 15,000 gpd	120,000.00 EA.
Package plant and sand infiltration bed (in place) 36,000 gpd	200,000.00 EA.

L.F. = Linear Foot
C.Y. = Cubic Yard
EA. = Each

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* Chronic problem areas may require more frequent pumping.

Table 4 -2
COMPARISON OF THREE STRUCTURAL ALTERNATIVES

	Reconstruction On-lot Systems with 1,000 sq. ft. Leaching Field	Install Communal System Using Septic Tank(s) and Leaching Fields	Install Package Plant with Sand Infiltration
40 - 1/4 acre lots			
Capital Cost	$87,000	$109,000	$144,000
Annual Operation and Maintenance Cost	1,000	2,000	19,000
40 - 1/2 acre lots			
Capital Costs	$87,000	$121,000	$156,000
Annual Operation and Maintenance Cost	1,000	2,000	20,000
40 - 1 acre lots			
Capital Cost	$87,000	$135,000	$169,000
Annual Operation and Maintenance Cost	1,000	3,000	21,000
100 - 1/4 acre lots			
Capital Cost	$217,000	$232,000	$299,000
Annual Operation and Maintenance Cost	2,000	3,000	25,000
100 - 1/2 acre lots			
Capital Cost	$217,000	$244,000	$311,000
Annual Operation and Maintenance Cost	2,000	3,000	25,000
100 - 1 acre lots			
Capital Cost	$217,000	$258,000	$344,000
Annual Operation and Maintenance Cost	2,000	3,000	26,000

Summary Matrix of Structural Solutions - The accompanying matrix attempts to summarize by community the alternative structural solutions presented in this chapter (and more generally described in Appendix C) for the Lower Charles River Basin.

Among the options included in the matrix (Table 4-3) are traditional sewerage with either local or regional treatment plants, as previously discussed under the sewering concepts; package plants, or communal subsurface systems with limited sewerage; and individual on-lot septic systems. Septage management options are limited to a formal program for the management and maintenance of septic systems and to disposal of septage at existing wastewater treatment facilities (see separate section at the end of this chapter).

In the structural matrix, wastewater management options are assessed for the existing and potential problem areas in each community. Two ratings are used to indicate the relative appropriateness and perceived urgency as judged by the MAPC's 208 staff at the present time. Letters are used to denote whether the proposed option is appropriate to solve existing or potential problems. The letter A means that the option is very appropriate; the letter B means that the option is appropriate; and the letter C means that the option is inappropriate to deal with the problems.

A rating of "very appropriate" (A) indicates that the option is likely to be technically and economically feasible, and environmentally and politically acceptable to the community. A rating of "appropriate" (B) indicates that the MAPC staff assessment identified possible difficulties (i.e. economic, social, political, etc.) in implementing this option.

Numbers indicate the time interval within which the management option could reasonably expect to be implemented. A number 1 denotes that the option is likely to be implemented in the short-range future (0-5 years); a number 2 indicates that the option may be implemented within the medium-range future (5-10 years); and a number 3 denotes options that should be studied for implementation in the long-range future (10-20 years). (The additional letter P indicates options presently in use, under construction, or in the planning stage.)

In developing the summary matrix, existing and potential problem areas within a community were rated according to:

- the technical feasibility of each alternative;
- geographic proximity to existing sewer systems or to those extensions now programmed;

TABLE 4-3
STRUCTURAL OPTIONS FOR THE LOWER CHARLES RIVER BASIN

OPTIONS/COMMUNITIES	Belmont	Boston	Brookline	Cambridge	Dedham	Lexington	Lincoln	Natick	Needham	Newton	Waltham	Watertown	Wellesley	Weston	COMMENTS
Wastewater Disposal															
1. Traditional Sewerage	3A	-	-	-	3B	3B	C	3A	3B	3A	3A	-	3A	3B	· See previous discussion of wastewater disposal and sewering concept for explanation of traditional sewerage and package plants.
2. Package Plants with limited sewerage	C	-	-	-	C	C	3B	3B	3B	C	C	-	C	3B	
3. Communal Septic Systems with limited sewerage	C	-	-	-	C	C	2B	2B	2B	C	C	-	C	1A	· For communal septic systems, maintenance and septage management, see Appendix C for definitions and explanation.
4. Reconstruction of Individual on-lot Septic Systems	2B	-	-	-	2B	2B	2A	1B	2B	2B	2B	-	2B	1A	
Septage Management*															
1. Management and Maintenance of Septic Systems	1A	-	-	-	1A	1A	1A	1A	1A	1A	1A	-	1A	1A	
2. Disposal at Existing Wastewater Facilities	P/A	-	-	-	P/A	P/A	P/A	P/A	P/A	P/A	P/A	-	P/A	P/A	

KEY: A: Very Appropriate
B: Appropriate
C: Inappropriate
-: Not Applicable (Almost 100 percent sewered population)

1: Short-Range Future (0-5 years)
2: Medium-Range Future (5-10 years)
3: Long-Range Future (10-20 years)
P: Present Circumstances

* The MAPC 208 Project is preparing a separate planning study of regional septage treatment and disposal options, including the need for new treatment facilities; this study report is expected to be completed and available late in the year.

- general physical features of the problem area; and
- estimated peak daily wastewater flows generated from all dwellings within the problem area.

B. NON-STRUCTURAL SOLUTIONS - LAND DEVELOPMENT CONTROLS

A variety of local regulations have been reviewed (in Appendix C) as techniques which are available to communities facing water quality problems. Table 4-4 is a brief guide for communities in directing their attention to those particular controls which are most appropriate for the problems of their community. It should be understood that the ratings indicated in the matrix are not intended as final recommendations for the community but rather as an indication of the utility of various solutions in the development of the community's comprehensive management program.

The ratings shown in Table 4- 4 indicate the relative applicability of the solutions to a particular community and do not mean that a community should consider only the solutions denoted by numeral "1", while disregarding those indicated by a "3". All of the rated solutions should be considered by a community, with the rating being a guide to the relative immediacy of the solutions' use. For example, a "1" indicates that a community now has a problem that a particular solution would be helpful in alleviating, and the community could take this action fairly immediately to address this problem. The numeral "2" generally indicates that a particular solution would be useful in the prevention of potential problems which are likely to arise in the near as more development occurs. The numeral "3" would indicate those solutions which the community should consider adopting or expanded use of in the long-run or in the overall re-evaluation of the community's development regulations in order to improve the management of water quality.

A brief explanation of the ratings within the non-structural matrix follows.

Wetlands Protection Districts - Several communities in the Lower Charles River basin are currently protecting their wetlands through local zoning. Some communities have a wetlands protection district, while other communities have included the wetlands in the mapping of floodplain protection districts or watershed protection districts. Any ranking for these communities has been omitted from the matrix, since they are now adequately dealing with potential problems in these areas. Dedham might extend the delineation of its floodplain protection districts to include some wetlands that are currently unprotected. Belmont, Brookline, Natick and Waltham do not utilize wetland zoning, which appears to be a useful regulation for the protection of their wetland areas. Watertown should work to ensure the protection of the currently unregulated wetlands in the Arsenal site.

Floodplain Protection Districts - Floodplain zoning is used throughout the basin, with eight communities currently utilizing it. Belmont might consider the use of floodplain regulation as an additional protection for the wetland areas mentioned, and Waltham should review the use of floodplain regulation for the protection of the Charles River and smaller streams. In Brookline, Cambridge and Watertown flood hazard areas are largely in public ownership, but the establishment of floodplain regulation may offer a more comprehensive water quality approach.

Aquifer Protection Districts - The ranking for the use of this regulation reflects a community's reliance on groundwater as the source of drinking water and the extent of the aquifer recharge area in the community. The majority of the communities in the Lower Charles Basin do not rely on groundwater for their drinking water and do not have known areas with high favorability for groundwater, and,therefore, any ranking has been omitted from the matrix. Lincoln's existing land use regulations do serve to protect water supply sources and so no ranking is included for the town. Dedham and Natick might well consider the use of an aquifer protection district for the protection of their areas of high favorability for groundwater. Needham, Wellesley, and Weston might also consider use of this type of land use regulation, although portions of the areas of high favorability for groundwater are partially protected by the towns' floodplain or watershed zoning districts.

Buffer Regulation - The ranking of the applicability of this regulation is based on the presence of streams or ponds in the community which are not completely protected by some type of regulation. Belmont, Lexington, Lincoln, Wellesley, and Weston have been omitted from the matrix, since their use of floodplain, wetland, or watershed districts would protect the streams and waterbodies. Other communities could consider the use of a buffer regulation in conjunction with or as an adjunct to their use of floodplain regulation or watershed protection districts.

Watershed Protection District - The towns of Lincoln and Wellesley do have watershed protection regulation, combined with their floodplain or wetland regulation. Many of the scattered ponds in the basin are included in existing environmental zoning districts or are surrounded by existing development, and some communities in the basin, such as Needham, Newton, Waltham, and Watertown might consider the future use of this type of regulation to offer further protection to these ponds. Although Dedham and Natick rely on groundwater for their water supply, the further protection of surface waterbodies would enhance the water resources of the community. Belmont, Brookline, and Lexington use the MDC for water supply,and Cambridge's Fresh Pond is surrounded by public land which provides protection to that pond.

Water Resource Protection Districts - The use of this regulation offers a community a comprehensive approach to the protection of surface and groundwater. Since many of the communities in the basin are currently regulating particular aspects of their water resources with separate protective zoning districts and with the relatively high level of urban development in the basin, this regulation has been omitted from the matrix for a number of the towns and cities. Dedham, Natick, and Waltham might consider this a useful approach in regulating their water resources.

Use and Density Regulations - While the ranking for the potential regulation of permitted land uses and the density of development generally reflects the extent of the potential conflicts between the existing zoning and the environmental capability of the land to support development, the overall high level of urbanization in the Lower Charles Basin does not make this technique of greatest significance to many communities. Some communities have generally reflected the environmental capability in their current zoning bylaws, and, therefore, many communities could review the permitted land uses and densities as part of an overall re-evaluation of their development regulations.

Cluster and PUD Regulations - While some communities in the basin currently have regulations either permitting cluster or planned unit developments, many communities may want to consider the increased use of this technique as a mechanism to minimize water quality problems. This technique could be useful in redevelopment in the more urbanized areas, as well as being suitable in the more suburban communities in the basin.

Site Plan Review - The site review controls listed within this matrix, i.e. grading and slope regulations, minimum open space requirements, and parking regulations, could best be utilized by communities in an overall program designed to take a comprehensive examination of land development controls. Adoption or expanded use of site plan review and site controls would not be best undertaken in a piecemeal fashion but rather as part of a comprehensive revision to land development regulation. Therefore, they are ranked for future consideration in all communities.

Subdivision Regulations - Most of the communities in the basin are using relatively recent subdivision rules and regulations as part of their land development controls and therefore this option does not receive the highest ranking. This is due to the level of urbanization in many of the communities in the lower portion of the basin. As communities undertake a revision to their current subdivision regulations, they should consider the inclusion of those aspects of subdivision regulations discussed in Appendix C. The use of sedimentation and erosion plans or an environmental impact review could be an expansion of the present role for subdivision control, and this should be undertaken by the community as a long-range action to help minimize generalized water quality problems.

Innovative Controls - A number of the land use control techniques which are discussed in Appendix C and ranked in this matrix for their applicability of the communities in the Lower Charles Basin appear to be regulatory devices which the community would want to consider for future use, as the communities take a long-range view of their current approach to the regulation of development. These more innovative controls, such as performance standards, growth management, and transfer of development rights, should be considered by communities in review of their current regulatory systems. They would not be more useful for immediate use in a piecemeal approach but might be incorporated into a town's comprehensive development system.

Other Alternatives - The ranking for acquisition of land and local health codes was based on a similar approach as that discussed with the innovative regulatory mechanisms. It is suggested that the communities should review the role of these two mechanisms as part of an overall review of the town's development regulations. The use of both acquisition of land and the local health code would be seen as part of the community's comprehensive management of water quality problems and not as a short-term solution to a particular source of water pollution. In particular circumstances, however, both alternatives might deserve more immediate concern and a higher ranking. For example, a community planning and inspection and maintenance program to extend the life of septic systems, and thus avoid or postpone sewering of certain areas, would integrate that program into its health code. Also, a community might find that land acquisition more immediately useful if it would preserve potential recreation lands which would threaten water quality if developed.

Table 4-4
NON-STRUCTURAL OPTIONS FOR WATER QUALITY MANAGEMENT

OPTION	BELMONT	BROOKLINE	CAMBRIDGE	DEDHAM	LEXINGTON	LINCOLN	NATICK	NEEDHAM	NEWTON	WALTHAM	WATERTOWN	WELLESLEY	WESTON
Development Controls ning atural Resource Districts													
wetlands district	1	1	-	1	-		1	-	-	1	2	3	-
floodplain district	2	2	2	-	-	-	-	-	-	1	2	-	-
aquifer recharge district	-	-	-	1	-	-	1	2	-	-	-	2	2
buffer district	-	2	2	1	-	-	2	2	2	2	2	-	-
watershed protection district	3	3	3	1	3	-	2	2	2	2	2	-	3
water resource protection district	-	-	-	1	-	-	1	-	-	2	-	-	-
se and Density Regulations	3	-	-	2	2	3	2	2	3	3	3	3	3
luster, PUD Regulations	3	3	3	2	2	2	2	2	3	3	33	3	3
ite Plan Review	3	3	3	3	3	3	3	3	3	3	3	3	3
grading and slope regulations													
minimum open space requirements													
parking area regulations													
salt storage													
bdivision	3	3	3	3	3	3	3	3	3	3	3	3	3
novative Controls erformance Standards	3	3	3	3	3	3	3	3	3	3	3	3	3
rowth Management	-	-	-	3	3	3	33	3	-	-	-	3	3
ransfer of Development Rights	3	3	3	3	3	3	3	3	3	3	3	3	3
her Options cquisition	3	3	3	3	3	3	3	3	3	3	3	3	3
ealth Codes	3	3	3	3	3	3	3	3	3	3	3	3	3

KEY:

1 = appropriate to deal immediately with identified problems.

2 = appropriate to prevent potential problems in the near future.

3 = should be considered as part of overall re-evaluation of development regulations to improve long-term water quality management.

- = currently in use or otherwise not applicable.

C. SOLID WASTE MANAGEMENT

The solid waste management heading is divided into two sections: landfills and future disposal. The first section on landfills lists measures to assess and correct water quality problems due to landfill leachates. Included are upgrading, closing and sealing, and water quality monitoring. Future solid waste disposal options include regional sanitary landfills (public or private), regional resource recovery, town landfills, and recycling.

In Table 4-5 , solid waste management options are rated by community according to their appropriateness for the specific problems discussed in the previous chapter. Also indicated is the future interval during which consideration of each alternative is deemed pertinent. These intervals are approximate and include: (1) near future (0-5 years), (2) intermediate future (5-10 years), and (3) distant future (10-20 years). Also indicated is a (P) for present circumstances, which include existing situations, actions in the process of implementation, and facilities under construction. Ratings of appropriateness are not necessarily given to present circumstances, since these conditions have evolved from past trends and factors which preceded the mandate of the Water Pollution Control Act Amendments of 1972. Future alternative solutions may be more fairly evaluated in light of recent water quality goals.

The appropriateness ratings include (A) very, (B) moderately, and (C) inappropriate. The staff ratings are judgemental and are based upon subjective weighing of numerous factors in addition to water quality enhancement. The assessments in the matrix are presented as a tabular summary of, and an adjunct to, information concerning community problems in Chapter 3, and structural solutions in Appendix C. To avoid the oversimplification inherent in tabular summaries, the text which accompanies attempts to explain the ratings and the factors involved in the evaluation.

Solutions to existing landfill problems or future disposal problems are considered and rated for the future time period in which they are considered relevant, given the adequacy of existing facilities, their life expectancy, and the lead time required for planning and implementing a given alternative.

General factors involved in the ratings of appropriateness of a solution to a landfill or solid waste problem include:

- water quality enhancement
- technical feasibility
- regulatory constraints
- cost-effectiveness

TABLE 4-5

SOLID WASTE MANAGEMENT
LOWER CHARLES

	Bos.	Bel.	Brk.	Camb.	Ded.	Lex.	Linc.	Need.	Newt.	Nat.	Well.	Walt.	Wat.	Well.
A. Landfills														
1. Monitor	A	A	A	A	A	A	A	A	A	A	A	A	A	A
2. Upgrade	-	-	-	-	-	-	-	1B	-	1B	1B	-	-	-
3. Close & Seal	1A	1A	1A	1A	1A	1A	1A	2A	1A	2A	2A	1A	1A	1A
B. Future Disposal														
1. Town Landfill	P	C	C	C	C	P	P	P	C	P	P	C	C	C
2. Regional Landfill	P	P	P	P	P	1A	1A	2B	P	2B	2B	P	P	P
3. Regional Resource Recovery	2A	2A	2A	2A	2A	2A	2A	2A	2A	2A	2A	2A	2A	2A
4. Recycling	A	A	A	A	A	A	A	A	A	A	A	A	A	A

Key:

A: Very Appropriate

B: Moderately Appropriate

C: Inappropriate

-: Not Applicable

1: Near Future (0-5 years)

2: Intermediate Future (5-10 years)

3: Distant Future (10-20 years)

P: Present Circumstances

Landfills - Presently operating landfills exist in six of the fourteen communities of the Lower Charles River Basin. The estimated remaining life at these facilities is a few years in Boston and Lincoln and close to 10 years in Needham, Natick, and Weston. The Lexington facility may be ordered closed in the near future despite a remaining capacity of roughly three years. In addition to these six operating facilities, there are former landfills in the remaining eight towns of the basin. These towns presently dispose of refuse at private regional landfills or incinerators located outside of the basin.

The first section of the solid waste summary matrix addresses steps to remedy deficiencies at the present and former landfills in the basin.

Water quality monitoring of each site in the basin is recommended as a first, necessary step in addressing the degree to which present and former landfills in the basin are affecting water resources. The time period during which monitoring is appropriate has not been indicated, since this determination depends upon the results of sampling at each site. Where a closed landfill gives evidence of continuing impact, monitoring should continue after remedial measures have been taken and should proceed until measurements indicate that a permanent abatement has been achieved. Similarly, monitoring should be conducted at present operating facilities as a check on the operation of the facility, and should continue beyond the closing of the facility to determine the adequacy of the capping procedure. In addition to providing information to assess impacts and operation, monitoring provides basic data necessary for the preparation of upgrading or closure plans. The type and intensity of monitoring required will vary both with the purpose and with the site itself. A further discussion of monitoring procedures and costs is presented in Appendix C.

Landfill upgrading is appropriate only at the facilities expected to continue operating into the intermediate or distant future (Needham, Natick and Weston). The extent of upgrading required is reflected by the appropriateness rankings. Where moderately appropriate, upgrading measures required may be limited to improved daily placement, cover, and grading practices. Subsequent operations should conform to both state regulations and the engineering plans of operation for the particular site. As mentioned previously, monitoring is necessary to evaluate the impacts at each site and degree of control measures required.

Near future closing and sealing of the Boston, Lexington, and Lincoln landfills is indicated in the matrix, as each of these facilities is reaching capacity. Closure plans should make use of monitoring and other site investigations to ensure long term protection of water resources. Interim operations prior to closure at these sites should conform with their engineering plans and with state regulations.

Closing and sealing of the former Belmont, Brookline, Cambridge, Dedham, Newton, Waltham, Watertown and Wellesley landfills in the near future is very appropriate.

Conventional closing operations generally include re-grading, compacting, sealing, and planting of the final 2-foot cover of loam, which is applied over the impermeable cover.

Future Solid Waste Disposal - The second part of the solid waste management matrix evaluates future disposal options for the basin communities. Each option is discussed and assessed on a general level in Appendix C.

New disposal facilities may be required by at least two basin communities in the near future. As previously mentioned, Lexington and Lincoln may close their town landfills in the near future. Other basin communities presently utilizing private regional landfills may also require new facilities in the foreseeable future as capacity is reached or environmental problems arise at these sites. Needham, Natick, and Weston are not expected to need new facilities for the approximately 10-year remaining life of their landfills.

Future disposal at new municipal landfills in communities presently not using this method is rated inappropriate as the requisite land availability is generally lacking. Utilization of private regional landfills by communities needing new facilities in the near future (Lexington, Lincoln) is considered very appropriate as this option provides an immediately available solution which can be utilized until potentially more favorable resource recovery alternatives become available in the region. Regional landfills can offer economic advantages for near-future disposal as these facilities may take advantage of economics of scale and avoid costly duplication of facilities at the town level. Environmental advantages may also accrue, as several large, well operated and well sited facilities can be acceptable from a water quality perspective.

Regional landfills are rated moderately appropriate in the intermediate and more distant future, as potentially more favorable resource recovery alternatives may become available to communities in need of new facilities during these future intervals. Resource recovery is rated more appropriate than regional landfills in the future because of projected advantages in costs, energy, materials, and water quality. Two resource recovery projects presently in the planning stage may be within hauling distance of most basin communities.

Long-range disposal options have been investigated in a study sponsored by Norfolk County, which includes Dedham and Wellesley. The Norfolk County Comprehensive Solid Waste Management Study (July 1974) recommended the formation of four districts to receive wastes from all the communities within Norfolk County, with each district to be served by a resource recovery facility. The resource recovery facilities were to be designed, constructed, and operated by private firms under contract to the county, which would operate all other required facilities. To date, the County has been unsuccessful in getting state enabling legislation required to implement the plan.

The Mass. Bureau of Solid Waste Disposal is also promoting the development of regional resource recovery facilities in this area, although not under County management. The 128 West facility proposed by the BSWD is in the site selection phase, with locations in Sharon, Stoughton, Weston, and Bedford currently under consideration. This project could be implemented in roughly 5 years assuming community acceptance and minimal delays. Member communities of the 128 West Refuse Recovery Council include Belmont, Lexington, Lincoln, Newton, Natick, Weston, and Wellesley. Communities which participate on a non-member basis include Boston, Brookline, Needham, and Watertown.

This project is one of seven facilities proposed under the state solid waste management plan, whose aim is to provide statewide coverage. The facilities would be privately designated, constructed, owned, and operated.

A third project is reported to be under consideration at or near the site of a private regional landfill in Plainville, Mass.

Recycling programs exist in several basin communities. These programs are voluntary and generally accept paper, glass and some metals. Quantities received generally comprise a small percentage of total municipal waste. These towns should continue and expand their programs, and the remaining towns should initiate active recycling. Benefits are primarily in resource conservation, but water quality may also be served by reducing the tonnage of waste landfilled. Economic benefits may also accrue, particularly to towns with high per ton disposal costs.

D. STORMWATER MANAGEMENT

The purpose of this section is to apply alternative solutions (described in Appendix C) to the specific stormwater runoff problems identified in the Lower Charles Basin. Due to the data problems discussed in Chapter 3 for both stormwater discharges and receiving water quality, this analysis is limited in terms of the solutions which can reasonably be considered. As stated earlier, at this time, there is no basis for evaluating the relative impact of cost-effectiveness of one solution over another. Until such data is generated, there will be no criteria or basis upon which to justify structural solutions or other capital-intensive, high operation and maintenance-dependant solutions. The emphasis of this preliminary report is therefore on the application of non-structural solutions or "Best Management Practices (BMP's) for controlling pollution from stormwater runoff. Best Management Practices for stormwater runoff control generally fall under three of the four possible control areas as described in Appendix C. They are at the land surface, on the road surface, and in the storm drainage system. Controls applied to the land surface, such as erosion and sedimentation regulations, are most typically applied in new or developing areas and are not well suited for controlling existing problems. Examples of road surface and in-system controls are street-sweeping, street vacuuming, catch basin cleaning or vacuuming, neighborhood sanitation, and brook channel maintenance.

Belmont

Operation and maintenance of the stormwater collection system is done by the Department of Public Works. Catch basins are cleaned at least once per year by a private contractor. Some cleaning of open channels is done when required. Recommendations to the town include the following:

- Key catch basins in the system should be identified and used as the basis for developing a regular catch basin cleaning program that includes provisions for more frequent cleaning in problem areas.
- Regular programs of outfall, stream and open channel inspection and maintenance should be developed and implemented.
- A program of limited street sweeping in heavily developed commercial-industrial areas should be evaluated by the town.

Boston

The Public Works Department Sewer Division is responsible for operation and maintenance of the stormwater collection system. Street cleaning is the responsibility of the Highway Division. The Sewer Division carries out a comprehensive program of

BMP's which is displayed in the following table. This is considered a good program by 208 staff. Recommendations to the city include the following:

- The PWD and the city's Health Department should begin to address alternative measures to control animal wastes throughout the city.

Brookline

The Highway Department is responsible for operation and maintenance of the stormwater collection system. Catch basins are cleaned at least twice per year. Some cleaning and flushing of pipes is done and trash gates at outfalls are cleaned. Recommendations to the town include the following:

- The city should evaluate the need for and cost of implementing a street sweeping program in the city.
- Outfalls and channels should be inspected and cleaned regularly.
- The Highway Department and the Health Department should begin to address the problem of animal wastes disposal.

Cambridge

The Cambridge DPW is responsible for operation and maintenance of the stormwater collection system. Catch basins are cleaned at least twice per year on a ten-month work schedule and some cleaning and flushing of pipes is done. Recommendations to the town include the following:

- The city should evaluate the need, feasibility and cost of implementing a street sweeping program.
- A regular program of outfall and channel inspection and maintenance should be developed and implemented by the DPW.
- The DPW and the Health Department should begin to address the problem of animal waste disposal.

Dedham

The Dedham DPW is responsible for operation and maintenance of the stormwater collection system. Catch basins are cleaned twice per year. Drains and brooks are cleaned as necessary. Recommendations to the town include the following:

- The town should begin to update its data base on the stormwater system as most of the information gathered by CDM came from Massachusetts DPW files.

- Regular programs of outfall and channel maintenance should be added to the current program.
- The town should evaluate the feasibility, need and cost of implementing a limited street sweeping program.

Lexington

Operation and maintenance of the stormwater collection system is done by the Lexington DPW. Catch basin cleaning is contracted out and done twice per year. The DPW is considering doing the work itself in the future. Some brook maintenance has been undertaken since 1973. Recommendations to the town include the following:

- Regular programs of outfall, channel and stream inspection and maintenance should be developed and implemented.
- Salting and sanding for snow and ice control should be carefully monitored in drianage areas discharging directly to surface water supplies or to areas feeding groundwater aquifer supplies.
- In planning for future development, maximum use should be made of natural drainage characteristics and non-structural runoff control measures.

Lincoln

The Lincoln Highway Department is responsible for operation and maintenance of the stormwater collection system. Catch basins are cleaned twice per year by a contractor. Recommendations to the town include the following:

- Regular programs of outfall, channel and stream inspection and maintenance should be developed and implemented by the Highway Department.
- Salting and sanding for snow and ice control should be carefully monitored in drainage areas discharging to surface water supplies or groundwater aquifer supplies.
- In planning for future development, maximum use should be made of natural drainage characteristics and non-structural runoff control measures.

Natick

The Natick DPW is responsible for operation and maintenance of the stormwater collection system. Catch basins are cleaned on the average of once every two years. Recommendations to the town include the following:

- The catch basin cleaning program should be upgraded to include cleaning on at least an annual basis with more frequent cleaning in problem areas.

- Regular programs of outfall, channel and stream inspection and maintenance should be developed and implemented.

- In planning for future development, maximum use should be made of natural drainage characteristics and non-structural runoff control measures.

Needham

The Needham Public Works Department is responsible for operation and maintenance of the stormwater collection system. Catch basins are cleaned on a regular basis, some as often as four times per year. Brooks are cleaned during the winter. This is considered a good program by 208 staff. Recommendations to the town include the following:

- Outfalls should be inspected regularly and cleaned whenever necessary.

- In planning for future development, maximum use should be made of natural drainage characteristics and non-structural runoff collection measures.

Newton

The Newton Public Works Department is responsible for operation and maintenance of the stormwater collection system. Catch basins are cleaned once every two to three years due to the large number (11,000) in the collection system. Catch basins are repaired and pipes rodded when necessary. Recommendations to the city include the following:

- The stormwater system should be studied to identify the catch basins within the system which would serve as a basis for developing a program of annual catch basin cleaning for key basins, more frequent cleaning in problem areas and less frequent cleaning in the remaining catch basins.

- Regular programs of outfall, channel and stream inspection and maintenance should be developed and implemented.

- A street sweeping program should be developed to augment catch basin cleaning activities in heavily developed and/or transportation intensive areas.

Waltham

Operation and maintenance work on the stormwater collection system is done by the Highway Department. Catch basins are generally cleaned at least twice per year. Other maintenance is done on brooks and pipes as needed. Recommendations to the town include the following:

- Street sweeping should be considered for use to augment catch basin cleaning activities in heavily developed areas.
- Regular programs of outfall and channel maintenance should be added to the program.
- Salting and sanding for snow and ice control should be carefully monitored in drainage areas discharging to surface water supplies or groundwater well field recharge areas.

Watertown

The Watertown DPW is responsible for operation and maintenance of the stormwater collection system. Catch basins are cleaned on a regular basis with some being cleaned as often as four times per year. Drainage pipes are also cleaned as required. Recommendations to the town include the following:

- Street sweeping should be considered to augment catch basin cleaning in heavily developed and transportation intensive areas.
- Regular programs of outfall, channel and stream inspection and maintenance should be developed and implemented.

Wellesley

The Wellesley DPW is responsible for operation and maintenance of the stormwater collection system. Catch basins are cleaned at least once per year and pipes are rodded on the average of once every five to seven years. Recommendations to the town include the following:

- Regular programs of outfall, channel, and stream inspection and maintenance should be developed and implemented.
- Salting and sanding for snow and ice control should be carefully monitored in drainage areas discharging to surface water supplies and groundwater supplies.

Weston

The Highway Department is responsible for operation and maintenance of the stormwater collection system. Catch basins are cleaned on an annual basis and pipes are inspected and rodded if necessary. Recommendations to the town include the following:

- Regular programs of outfall, channel and stream inspection and maintenance should be developed and implemented.
- Salting and sanding for snow and ice control should be carefully monitored in drainage areas discharging to surface water supplies and groundwater supplies.

E. SEPTAGE MANAGEMENT

Only 5 percent of the population of the Lower Charles River Basin communities rely on septic systems and all septage generated in this basin is disposed of into MSD sewers by licensed pumpers. Septage management is not generally considered to be a major issue in this basin. Lincoln and Weston are the only two non-MSD member communities which rely completely on subsurface disposal systems. Septage from both of these communities is hauled by licensed pumpers and discharged into the MSD system under contract.

Approximately 22 percent of the population of the entire Charles River Basin communities is served by septic systems and a total of 57,000 gpd of septage is generated. A total of 24,800 gallons per day of septage is generated in the Lower Charles River Basin.

A separate report on regional septage treatment and disposal options is currently in preparation by the MAPC 208 project. Community-specific recommendations based on that report will be included in the final basin report. This report will discuss all presently available technologies for the treatment and ultimate disposal of septage, including co-treatment at an existing sewage treatment plant, separate sewage treatment, composting and land application of septage. The report is expected to be completed by the end of November, 1977. Therefore, no analysis of existing septage management practices and recommendations for future treatment and disposal are being presented in this basin report.

Chapter 5

Assessing a Comprehensive Management Program

CHAPTER 5 ASSESSING A COMPREHENSIVE MANAGEMENT PROGRAM

In this chapter, you will find:

A. An overview of the development of a comprehensive management program.

B. A brief note on how the alternative management programs can be assessed.

C. The DeFacto Projection, a continuation of present trends and policies into the future is assessed.

D. Alternative I, a comprehensive management program with maximum reliance on sewering is assessed.

E. Alternative II, a comprehensive management with reliance on non-sewering solutions is assessed.

A. DEVELOPMENT OF COMPREHENSIVE MANAGEMENT PROGRAM

The central and overriding recommendation of this report is that each of the communities in the basin should formulate a comprehensive wastewater and water quality management program. This program must adequately address existing water quality issues and insure that similar problems do not arise in the future. The development of such a comprehensive program can involve the use of many of the solutions discussed in Chapter 4 so as to establish a coherent program for managing water quality. Both structural and non-structural solutions can be used together in creating a total approach to a community's water quality problems. The means by which these solutions are linked together will establish the comprehensive management program.

The formulation of such a comprehensive program is no easy task for a community. Clearly, no one combination of solutions fits the needs of every town. Each program must be tailor-made. The combination of solutions must respond to existing water quality problems, and it must be consistent with the community's short and long-range goals. To be effectively and successfully implemented each comprehensive management program should respond to the following questions:

If chronic septic system problem areas are identified, how should the community proceed?

a. reconstruction of septic systems

b. communal systems with small sewers

c. package plants with small sewers

d. extensive sewering with treatment at a sewage treatment plant

If the community wishes to rely on septic systems, how can it insure the longevity of this solution?

a. design septic system inspection and maintenance programs to fit the particular needs of a town

b. enforce rigorous installation requirements to guarantee installation of septic systems where minimal negative water quality impact would result

c. develop overall zoning districts to reflect soil characteristics as well as geologic and hydrologic considerations (e.g., drainage areas, aquifer recharge areas), and limit permitted land uses on those fragile areas to low- and moderately low-density uses which can successfully utilize on-site disposal methods.

If areas of the basin continue to rely on septic systems, how can towns ensure that adequate septage treatment facilities are available?

a. separate treatment at a new treatment plant

b. treatment at existing sewage treatment plant

c. pretreatment and discharges to sewage treatment plant

d. land application

What level of management would be the most appropriate for the facility(ies)?

a. single-town only

b. multi-community arrangements or contracts

c. basin-wide agreements

If a landfill is identified as a problem, what sort of solution is appropriate?

a. more stringent regulations and enforcement pertaining to siting and maintenance

b. closing or capping of abandoned fills

c. monitoring of suspected problems

d. evaluate long-term effectiveness of current solid waste disposal methods and consider feasibility of regional landfills or resource recovery operations

Where low flow and possible groundwater contamination are seen as problems, how should the community undertake to solve this problem?

a. aquifer recharge area protection

b. stormwater detention

c. impoundment and slow release

d. maintenance of headwater wetlands

e. water conservation program and industrial recycling

If hydrologic modifications are identified as contributing to water quality problems, what type of solution is appropriate?

a. removal of unneeded structures

b. allow river to return to natural course where it has been straightened

c. dredge behind dams

d. restrictions on further modifications

If lake eutrophication is a problem for the maintenance of water quality, how should the community proceed?

a. erosion control on watershed land

b. modify dam operation

c. federally aided (Sec. 314) lake restoration program

d. stormwater runoff program

If flash flooding results from streams being unable to absorb the high water volume that is introduced quickly during storms, which approach offers the most feasible solution?

a. impoundment and slow release

b. maintenance of headwater wetlands areas

c. eliminate constrictions

d. culvert maintenance program

If potential non-point source problems are identified, how should a community respond in selecting a number of approaches to protect critical areas?

a. zoning changes, for instance the adoption of wetlands or floodplain bylaws

b. consider suitability of watershed protection or aquifer protection bylaws to safeguard surface and groundwater reservoirs

c. consider use of stream buffers to keep banks of water courses in a natural state, thereby lessening likelihood of possible negative water quality effects, including, for example, erosion

d. consider implementation of a comprehensive water resources protection district to streamline overall regulatory structure in a town, while providing protection for all water resources. If so, the following questions must be considered:

Which of a number of density regulations would be appropriate?

Would clustering be useful in preserving open space and lessening land development costs?

Which site controls should be employed to control erosion and runoff and other potential water quality problems?

a. grading and slope regulations

b. regulations on the storage of salt and hazardous materials

c. site plan review

d. minimum open space

e. earth removal

Which of several "innovative" strategies might serve as a model for revising land use planning and regulation?

a. performance standards

b. phased growth

c. transfer of development rights

Different solutions for water quality problems will have different effects for a town. In choosing among many solutions and combining solutions into a comprehensive program, each community should consider a number of key issues.

What Will the Solution Cost? - Cost is the primary issue of concern to a community when considering the use of possible solutions for water quality. There are several important components to the question of potential costs of a particular solution, and a community should be aware that a simple comparison of total cost figures of alternative solutions can be deceptive.

A variety of costs, both long- and short-term, are associated with some solutions for water quality. Certainly short-term costs are of importance, since these represent the first fiscal effects of a solution, but a community must also consider that many of the available solutions have on-going costs such as operation and maintenance expenses, which will continue for the entire life of the solutions. For example, solutions involving sewers will entail considerable capital costs for the construction of the collection system and the treatment plant. On the other hand, a system of municipal maintenance of septic systems involves a much lower initial level of capital expenditure. However, both types of systems involve on-going personnel and maintenance or administration costs, and a community must include these costs when comparing relative costs of alternative solutions.

Financial Assistance - When analyzing possible total costs of various management options, a community should consider the available sources of funding. Federal and state assistance is available for some solutions, and in some cases only a small percentage of the total cost would be borne by the local government. In the case of traditional sewering solutions, federal and state funding is presently available for up to 90 percent of the capital costs of treatment facilities. This funding does not currently apply to construction of the smaller sewer pipes (laterals) in the collection system. It should be emphasized that as the law now stands this funding only applies to the capital costs of a sewering solution and that the significant on-going costs associated with the operation and maintenance are not eligible.

Who Pays? - Another factor which should be considered when analyzing potential costs is who at the local level actually pays for the solution. With the use of individual septic systems, for example, costs for both construction and maintenance are the responsibility of the private homeowner. In the case of communities using sewer solutions, user charges which apply to private homeowners are employed to pay for the operation and maintenance of the system. With this solution, users of the sewer system pay a cost based on the flow and strength of their discharges. The effect of the initial connection costs and the yearly charges on the individual homeowner must be considered, as well as the possible effect on economic activities. When using a traditional sewer solution, a program of Industrial Cost Recovery is instituted whereby major industrial users of the system are charged a share of the total capital cost of the treatment plant according to use.

How Will the Solutions Affect the Ability of the Community to Accommodate Projected Growth? - The pressure for future growth in the basin is expected to be considerable. Certain solutions discussed in Chapter 4 and Appendix C will increase the capability of a community to handle growth. Sewering, for example, will allow a community to accept greater numbers and a higher density of residential units, as well as economic activities. However, some solutions (e.g., large lot zoning) tend to be land consumptive and preclude future possibilities for development.

Will the Solutions Act as a Stimulus to Growth? - It is sometimes stated that the construction of sewers is an incentive to growth, although this issue is not resolved. It is not merely the existence of sewers that stimulates growth, but rather how sewers are used in the overall land management program of the community. Sewers could in fact act to control growth by guiding and limiting future development to certain sections of the community. Other sections of the town could remain in low density use and proper non-structural solutions could be applied.

What Effect Will the Solution Have on the Diversity of Land Use Types? - Some of the basin communities are relatively homogeneous regarding land use. A pattern of single family houses with limited clusters of commercial development predominates. The choice of solutions will clearly be a determinant of whether this homogeneity will continue in the future. By utilizing sewerage - either large scale or limited to small clustered sections - a community could allow for a greater diversity of land activities. On the other hand, by continuing to predominantly rely on on-site waste disposal, a town could prevent certain high intensity uses from locating. The long-term implications of these actions should be noted. Communities which do not presently wish to encourage the siting of economic activities, may in fact be precluding future opportunities which could provide valuable support of the town's economic base.

How Will the Solutions Affect Housing in the Community?- Home builders associations argue that the imposition of environmental controls, e.g. site plan review, environmental impact statements, etc. significantly affect the cost of housing. They contend that since a large proportion of the cost of a house is the land upon which it is build, a town can in fact influence the cost of a house by regulating lot sizes.

By allowing for an alternative to on-site waste disposal a community can encourage a diversity of housing types. Clustered townhouses or apartments can become an alternative to large lot single family houses, and in some cases, may provide a lower cost alternative. This latter consideration is significant in addressing the issue of the community's responsibility in meeting its share of regional housing needs. Cities and towns must be aware of the dramatically rising costs of housing in the region. Within a decade the costs of almost any new single family house could be well out of the reach of the majority of the population.

Will any Significant Environmental Effects be Precipitated by the Solution? - Certain sewerage schemes could affect the quantity of groundwater recharge, if the ultimate disposal were either out of basin or to the ocean. Some sewerage schemes would not result in loss of recharge, if for example, land application or sand infiltration were employed. (It should be noted that no absolute causal effect between sewering and loss of recharge has been universally proven. The possible effects must be studied on a community-level basis.)

Is the Solution Long or Short-Range? - Is the solution part of a long-range planning program? Or, is it merely a stop-gap measure? Improperly sited and maintained septic systems are only an interim solution, while a septic system maintenance program could transfer that approach to a longer range alternative.

How Does the Solution Relate to the Growth Policy of the Community? - Many of the towns in the basin have recently completed growth policy statements which express each municipality's goals and objectives for future growth. The growth policy of a town should be a basic tool in the choice among solutions, and any solutions chosen should be consistent with the growth policy of the community.

B. ASSESSING THE CONSEQUENCES OF A COMPREHENSIVE PROGRAM

While the phrase "impact assessment" may have only recently begun to appear in many planning reports and articles, the concept embodied by the term is certainly not a new one. Before a decision is made to proceed with some action or program, an examination should be made to determine what the consequences of that action would be. Far from being a new concept, this is the basis of logical decision-making. The process can be utilized as a useful format for the public discussion of governmental decision-making.

Aside from satisfying certain state and federal requirements, impact assessment is a rational planning tool through which the adverse and beneficial effects of alternative solutions can be identified. The presentation of this information to the public facilitates easy comprehension and evaluation of the alternative approaches to water quality management.

It is important in this process that long-term, as well as short-term effects of a potential action be examined. It is sometimes the case that decisions are primarily influenced by immediate consequences, while there are other effects which, in the long-run, may have even more important impacts.

For illustrative purposes of the types of effects that a community would want to look for in reviewing possible water quality programs, three possible comprehensive programs for water quality management have been summarized in this chapter.

Three examples of possible programs for water quality management will be helpful by illustrating how various solutions as discussed in Chapter 4 can be used together to create a comprehensive program. It is hoped that communities can utilize these example programs as they consider the program which best accommodates the goals and policies of their community, while managing water quality problems. These examples of water quality management programs involve the combined use of structural solutions as represented as Concepts in Chapter 4, and non-structural solutions to water quality problems. The example alternatives differ in the way the solutions are combined and in the emphasis placed on the structural and non-structural components of the management programs.

The alternative management programs presented here are developed by combining both structural and non-structural solutions to particular water quality problems and presenting these solutions as a comprehensive program for water quality. The structural component of each management program represents one of the Concepts discussed in Chapter 4, and since these Concepts utilize only structural approaches to water quality, the necessary non-structural solutions are incorporated into each management program. These programs address both existing water quality problems and potential problems which may develop as future development takes place. For example, areas where the current zoning permits land use density or types of development which exceeds the natural capacity of the environment would be areas where potential problems should be addressed. An example might be a wetland area which is now zoned for industrial use, and for such an area, a zoning change could be included in the management program.

The alternative approaches to water quality management, as summarized in this chapter, indicate some core decisions to be made regarding an approach relying predominantly on sewer construction and one which relies more heavily on non-structural regulations for the management of water quality. Not all aspects of a comprehensive water quality management program are included in these alternatives, and some topics, such as regulation of salt use and storage, landfill regulation, stormwater management and septage management, are not discussed. As consensus is reached on the core decisions on water quality management, then these other elements of the program can be added.

A key role in the determination of a comprehensive program that is best suited to the goals and policies of a community is active participation by local residents with public officials in determining the most appropriate solutions to be used. In many instances there is more than one solution technically available for solving an existing or potential water quality problem. Therefore, subjective value judgement must also play a role in the public decision-making.

Public participation is vital to the overall success of the water quality program, as final recommendations should reflect the community's preference in developing a management structure. In order to facilitate a maximum level of public use of assessment information, data used in the assessment has been maintained at a level that permits fairly quick comprehension with a minimum of background information. A more detailed description of the methodology, the sources used in the development of the DeFacto Projection and the various assessment categories is presented in the Appendices of this report, published under separate cover and available upon request.

The three alternative management programs summarized here offer a broad range of approaches to the management of water quality. The first alternative, the DeFacto Projection, represents a continuation of present trends and policies extended into the future. Alternative I represents a maximum reliance on traditional engineering approaches to wastewater management, primarily concerned with new and extended sewer service areas. Alternative II relies to a maximum degree on non-sewering as a wastewater management solution, while turning more attention to land development controls to control water pollution. For the sake of brevity, Tables 5-1, 5-2 and 5-3 present in matrix form a summary of the impact analysis following a discussion of each alternative. The potential consequences of each alternative for ecological, social, economic, land use, and management aspects are discussed.

C. DEFACTO PROJECTION

Definition - The DeFacto Projection is a growth projection developed by the MAPC Water Quality Project to indicate what the metropolitan growth patterns in the Boston area would be in 1995 if current public and private development practices are continued. This projection is intended to offer a view of what the likely result would be of simply extending current trends into the future and can be characterized as an extension of the status quo or "no action" alternative. Specifically, the projection involves a continuation of current zoning and public authorities for decision-making. Sewerage facilities which have reached the Step 1 level of the 201 construction grant process are included in this projection. This work is a representation of what the future growth picture might be if no additional environmental constraints, other than what currently exists, are placed on the development process.

It should be emphasized at the outset that the DeFacto Projection is in no way intended to be an in-depth land use plan for each of the communities in the project area. The DeFacto Projection is not intended to be prescriptive in any way. Rather, it is a descriptive planning tool at a fairly general level. It is not a recommendation of the 208 project.

In summary, the DeFacto Projection is composed of two main parts; one portion is concerned with the supply of land available for development, while the other part focuses upon the projected demand for additional land. In order to accommodate future changes in population and employment over the next 20 years, additional land will be developed for residential, commercial and industrial land uses. The end result of this projection is a graphic, quantitative representation of land available for future development in the basin, together with an evaluation of the relative growth pressure on land for those uses now permitted through local zoning regulations. Additionally, the DeFacto Projection indicates the amount of land development which will be necessary to accommodate the anticipated 1995 growth. Together this information should offer a picture of the future growth pressure in the area, and the ability of the area to absorb this growth through the continuation of current development policies.

Lower Charles Basin Projection - The DeFacto Projection indicates that the communities analyzed in the Lower Charles Basin Report will gain approximately 12,000 new residents by 1995, representing more than a one percent increase over the 1970 population. In comparison to the previous twenty years, the projected growth rate is a reversal of the 6 percent decline in population which occurred between 1950 and 1970.

The population increase for these communities obviously will influence housing, and approximately 8,500 additional housing units will be added to the existing stock by 1995 to accommodate the additional population projected by 1995. Based on present residential zoning densities in the basin communities, accommodating these additional housing units will require approximately 5,600 acres of land.

The total amount of development anticipated by 1995 is almost 6,500 acres, with almost 8 percent of all new development being residential in nature. Thus, many communities in the basin will maintain their current residential character. Commercial and industrial development are each estimated to comprise roughly 6 percent of the land development over the next twenty years.

Impact Assessment - Highlighted below are some of the most significant impacts which could result from the DeFacto Projection, followed by Table 5-1, which indicates the potential consequences in a summary table. A complete discussion of the potential impacts can be found in Appendix D to this report.

- The potential impacts on the local tax rates of the committed sewerage projects in the Lower Charles River Basin are discussed for Boston and Cambridge. No information is presently available on on-going facilities in the other basin communities. This analysis does not include work related to the Eastern Massachusetts Metropolitan Area Study.

Summary Impact on Municipal Taxation

City	Net Capital Cost	Year One	Year Five
Cambridge	$540,000	$1.71	--
Boston	$12,715,436	1.87	$1.53

- As the communities increase in population, towns can benefit positively from the increased tax revenues from additional development, and there can be municipal costs associated with the services required by the development. As a continuation of the existing trend, which is predominantly a low-density pattern of development for the outlying suburbs in the basin, the cost of providing municipal services will mean a higher cost to the communities as growth continues.

- The continuation of existing patterns of development could have a slightly negative affect on groundwater and recharge, as development occurs in areas important for groundwater supply. Possible effects could be a reduction in recharge and possible contamination of the supply. However, positive impacts for groundwater are also evident in some areas of the basin through the use of environmental zoning districts, which do provide some protection to areas of groundwater favorability.

- Slightly negative impacts result from the pressure for growth in areas with potential for erosion, and this occurs most notably in Natick. Potential flood control problems do occur in certain growth pressure areas, however, such consequences are not substantial throughout the basin, being predominantly in Natick and Lexington. Potential drainage problems appear to be moderately significant in several towns in the basin and being notable in Waltham, Natick and Lexington.

- With growth and development dispersed throughout those areas of the basin having a high capacity as potential wildlife habitats, a slightly negative impact couls result for wildlife. This reduction of wildlife habitats would be of long-term consequences for the basin.

- The approximately 8,500 housing units anticipated from the increase in population in the projection means that over 5,600 acres of residential land will be developed. With five basin communities having approximately one-half of their residential land zoned for over one-half acre lots, a striking feature appears in relation to the cost of housing. With an acre home site in the metropolitan area costing between $17,000 and $20,000 the low-density of residential development will increase the cost of housing. (This would be most significant in Lincoln and Weston which have over three-quarters of their residential land zoned for at least one acre lots.) At the regional level, the potential housing impacts become more apparent. With the larger lot sizes and increasing land costs, a barrier to full access to housing in some towns may be created for residents throughout the region.

- With most of the anticipated development located adjacent to existing open space being low-density residential development, impacts on this open space would be minimal. Where the outlined environmental zoning districts are adjacent to or include open space areas, the additional development constraints of these regulations would enhance the recreational opportunities of the open space areas.

- Anticipated development could have some negative effects on a few archaeological sites. Low or moderate density residential development would not be incompatible as an adjacent land use and would have only minimal impact. No historic sites will be negatively affected by the projected growth.

- A few significant landscape areas are affected by potential development with the impacts being slight because of the low-density nature of the residential development. However, complete development of any of these sites, even with relatively compatible low-density development, would destroy the natural landscape qualities.

- Potential effects of this projection could influence various economic sectors in the basin. The improvements to the sewerage and storm drainage systems incorporated in this projection are estimated to result in about 4,400 person years of employment during the construction phase.

- Possible effects of this projection indicate that approximately 22,000 person years of residential construction employment will result from the residential growth resulting from the net change in population. Additional housing will be build as a result of the redevelopment process taking place in the urban areas. This level of building activity, being significantly below the period of 1950 to 1970, does not create a positive effect for an industry which is now experiencing a high unemployment level.

- It is projected that the consistent decline in agricultural land over the past will continue with conversion of land from agricultural to urban development. This will create an adverse impact on agricultural employment, which is projected to decline over the next twenty years.

- Manufacturing employment, which now represents less than one-fifth of the total employment in the basin, is estimated to decline in relative importance over the next twenty years to less than one-tenth of the total employment. Since about one-quarter of the current manufacturing employment is considered to be in "water-intensive" activities, and therefore, most affected by wastewater management, a slightly negative effect may result for manufacturing employment from this projection.

- Residential land constitutes the predominant amount of the total anticipated demand for land, with about 87 percent of the total demand being residential in nature. The amount of land anticipated for commercial development is about six percent of total new development, with six percent of the demand for land over the next twenty years also being for industrial development.

Management Impacts - The DeFacto Projection will have moderate impacts on the existing institutions in the Lower Charles Basin. MSD-member communities (Natick, Wellesley, Waltham, Lexington, Belmont, Watertown, Newton, Cambridge, Brookline, Boston, Dedham and Needham) must have in effect a sewer use by-law or ordinance no less stringent than the sewer use regulations of the MDC, once the currently proposed regulations are promulgated, together with procedures and adequate resources for monitoring and enforcing compliance with such a by-law or ordinance. This will mean the revamping or promulgation of new ordinances in most MSD communities.

Other MDC requirements as to user charges and industrial cost recovery will also place a significant administrative burden on all MSD communities as generally existing accounting and sewer use charge billing practices in the member communities do not meet the user charge/industrial cost recovery requirements of PL 92-500. Staff and resources will be needed to develop the required system and to perform ongoing accounting, record keeping, and billing functions. It appears that MDC will concentrate first on developing user charge systems with industrial cost recovery systems developed in the second phase of the program. Of course, pending amendments to PL 92-500 could substantially change these requirements.

The MDC currently allows non-MSD member communities to discharge septage into their system provided a contract has been executed between the MDC and the community seeking disposal privileges. The MDC has recently notified all non-member communities that they will have to find some alternative means of septage disposal after December 31, 1979. Additionally, MDC has recently notified non-member communities discharging septage to the system that they must file an "implementation schedule" with the MDC by September 30, 1977 with progress and status reports to be filed each following January and June. Unless these reports are received, indicating progress towards meeting the December 31, 1979 final termination date, then no renewal contract will be issued for the period beginning July 1, 1978. This action has significant ramifications for the non-MSD communities of Lincoln and Weston which currently discharge septage to the MSD system.

An additional legal and institutional impact of the DeFacto Projection is the effect that town responsibility for the permitting and control of all subsurface disposal systems under 15,000 gallons/day under Title 5 of the State Environmental Code will have on local health boards. This increased responsibility will mean a greater need of technical expertise and administrative assistance. Whether communities will attempt to assume this responsibility and the additional costs by acting alone or in concert with neighboring communities depends upon a number of related factors including future growth pressures and future state action in the form of legislative appropriations to reinvolve the state agency, DEQE. As only two communities in the Lower Charles Basin rely totally on septic systems the impact of this regulatory change will not be as severe as in other parts of the state. Also, much of the area is developed so that growth dependent upon septic systems will not be significant.

The DeFacto Projection will have minimal additional impact on other existing institutions and agencies. Other local authorities, particularly those having land use authority such as planning boards, conservation commissions, zoning boards, boards of health would continue to function within their present scope of authority.

Table 5-1. DeFacto Projection Impacts

Impact Categories / Alternatives	DIRECTION	MAGNITUDE	DURATION	SIGNIFICANCE
Legal and Institutional Implications				
legislative				
institutional		M	L	L/M
Water Quality and Supply Impacts				
ground water	-	S	L	L/M
Environmental Impacts				
erosion	-	S	L	
flood control	-	S	L	L/M
drainage	-	M	L	L/M
recharge	-	S	L	L/M
wildlife	-	S	L	
air quality	o			
Social Impacts				
housing	-	M	L	L/R
recreation and open space	+/-	S	L	L
archeological and historical	-	S	L	R/N
aesthetic	-	S	L	L
Economic/Employment Impacts				
water quality related employment	+	M	S	L/R
manufacturing	-	S	L	L/M
construction	-	M	L	L/M
agriculture	-	S	L	L
Governmental Impacts				
taxes and assessed valuation	-	S	S	L
induced costs or municipal service requirements	-	M	L	L
Land Use Impacts				
population		S	L	L/M
residential land use		M	L	L
commercial land use		S	L	L
industrial land use		S	L	L
transportation	-	M	L	M

gend:

rection = += positive impact
-= negative impact
O= negligible impact

gnitude = S= slight impact
M= moderate impact
E= extensive impact

duration = L= long-term impact
S= short-term impact

significance = L= local significance
M= multi-local significance
R= regional significance
N= national significance

D. ALTERNATIVE I - MAXIMUM RELIANCE ON STRUCTURAL SOLUTIONS

Description - This alternative represents a maximum reliance on a traditional engineering approach to wastewater management and includes an extensive use of sewers (structural solutions) for solving existing problems and future problems. The potential sewer service areas in this alternative incorporate those areas outlined in Concept I, which was discussed in Chapter 4. In this alternative, sewer service areas are outlined which include all existing water quality problem areas; and the undeveloped land zoned for higher density use and adjacent to the existing problem areas; and all potential problem areas. (See Figure 9.)

The existing problems would be remedied by the availability of sewers. The provision of sewers to those undeveloped lands in close proximity to these problem areas would help prevent future water quality problems when those areas are developed. The use of sewers would prevent future problems in those areas considered as having potential water quality problems as development occurs.

Having addressed the water quality of these areas with the use of the outlined sewer service areas, increased density of development can be accommodated without threatening water quality since sewers reduce the restrictions on development based on the natural capacity of the land. Therefore in these areas outlined for sewer service, the zoning for development could allow at least moderate residential density. In this alternative, in the potential sewer service areas, any lower density zoning could become moderate residential density with minimum lot sizes between 21,799 and 8,713 square feet.

Another component of this comprehensive management program is the use of wetland protection districts as a device for preventing water quality problems in all currently unprotected wetlands in the basin. The use of this zoning regulation will ensure that inappropraite development will not interrupt the natural functions of the wetlands, such as water supply, flood control, entrapment of sediment and pollutants, and the protection of wetlands vegetation and wildlife habitat. Also unprotected floodplain areas are outlined for regulation with a floodplain protection district. The development of incompatible land uses would be regulated, in order to provide public safety protection by affording natural storage area for floodwaters and to prevent water quality problems associated with greater volumes of water, greater sediment yields, and contamination from runoff.

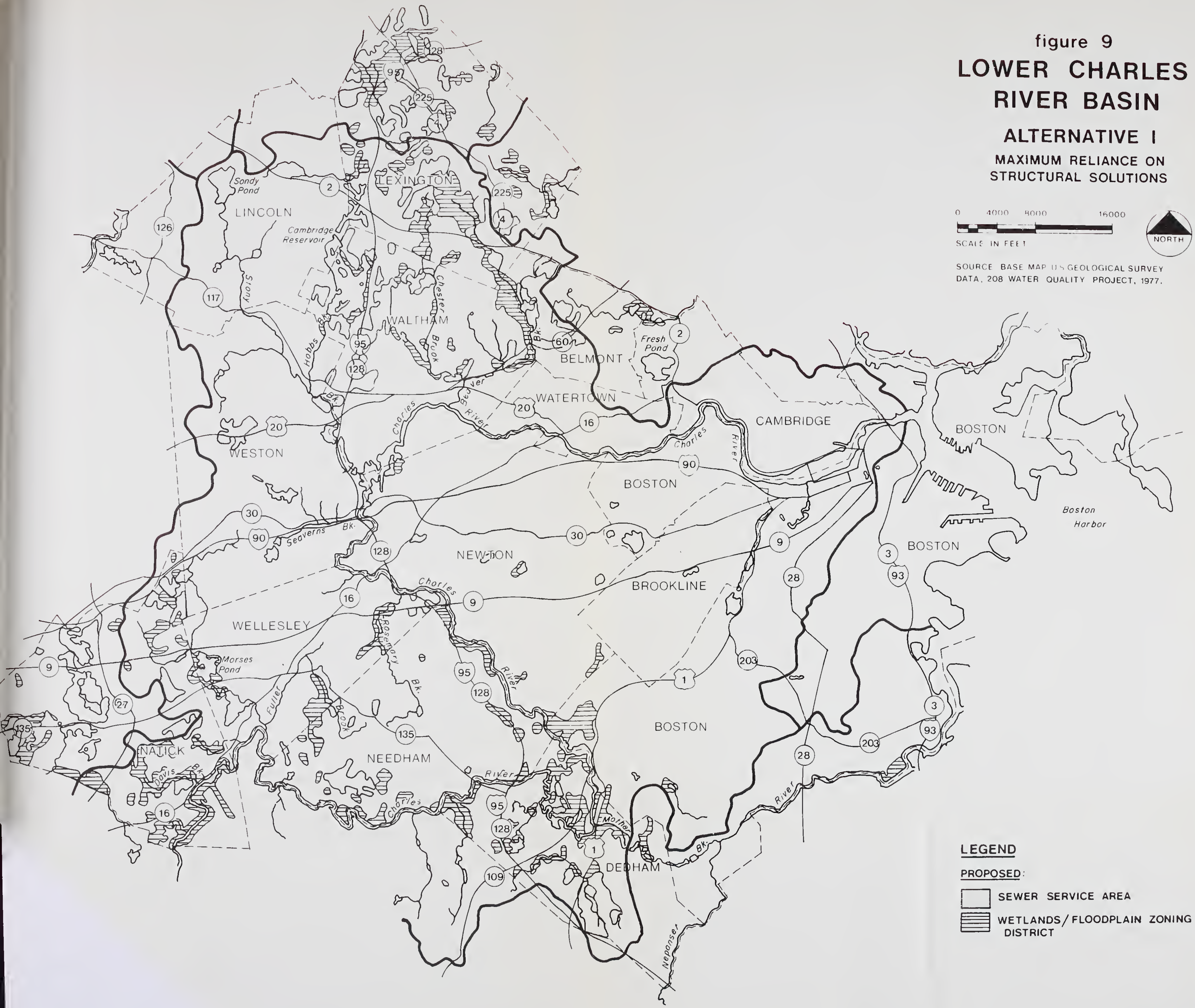
The implementation of the Wetlands Restriction Program would also be an appropriate technique to ensure the protection of currently unregulated wetlands in the communities of the Lower Charles. Several communities are now involved in various stages of the Wetlands Restriction Program. As this work proceeds and the restrictions are recorded, then that could be considered as an alternative to the wetland zoning outlined as part of this management program.

figure 9

LOWER CHARLES RIVER BASIN

ALTERNATIVE I

MAXIMUM RELIANCE ON STRUCTURAL SOLUTIONS



SOURCE: BASE MAP U.S. GEOLOGICAL SURVEY
DATA, 208 WATER QUALITY PROJECT, 1977.

LEGEND

PROPOSED:

☐ SEWER SERVICE AREA

▤ WETLANDS/FLOODPLAIN ZONING DISTRICT

Work is also proceeding on the Natural Valley Storage Project of the Army Corps of Engineers, this project involves a number of communities in the basin which have flood control acreage included in the project. To some extent, these areas coincide with the areas outlined for the use of wetlands or floodplain zoning in this management alternative. As the implementation of the Army Corps project proceeds and areas are acquired for flood control purposes, then the necessity of regulating these areas through local zoning would be eliminated. Any remaining unregulated wetlands or floodplains could be protected by a local zoning by-law.

The current zoning for all of the remaining areas of the basin remains unchanged in this management program.

Impact Assessment - The following discussion outlines more of the most significant potential impacts of Alternative I. These impacts are summarized in a matrix (Table 5-2) in order to provide an overview. A complete discussion of the potential impacts can be found in Appendix D.

- There would be no impact on the local tax rate under Alternative I, outside of those discussed as part of the EMMA study. Reference should be made to the EMMA study for the potential costs for wastewater treatment as outlined in that study.

- Based on a somewhat more concentrated pattern of development and not relying totally on a sprawl pattern of development at a relatively low-density of development in the outer suburban towns in the basin, the cost of providing many municipal services could be lower than would be anticipated in the DeFacto Projection. By accommodating the same amount of growth in a less land-consumptive manner, cost savings result for the delivery of such services as police, fire, solid waste, highways, and utilities in both capital costs and in the costs of operation and maintenance. Such costs savings could be up to 10 percent less that with sprawl development under the DeFacto Projection.

- In those areas indicating the use of sewer service, the permitted residential density could be increased to a moderate density of 21,799 to 8,713 square foot lot sizes without posing potential degradation to water quality. Since the cost of land and site development is a significant factor in the total housing cost, the moderate density development would mean that on-site development costs would be reduced by a minimum of one-third. This could be a factor in providing more moderately-priced housing in the outerlying basin communities and could permit the potential development of a greater diversity of housing types. However, environmental zoning districts would create some negative effects on housing by creating constraints for development in these areas and contribute to higher costs of available land.

- The provision of sewer service and the accompanying increase in residential density could produce some negative effects for some areas important for groundwater supply. In these areas the infiltration of water treated by septic systems would be reduced and wastewater would be carried to another location for treatment. This would result in groundwater recharge being reduced. Also with increased density of development comes increased consumption of groundwater through the pumping of some local wells. However, where the environmental zoning districts coincide with areas important for groundwater, partial protection would be provided and would have a potentially positive effect.

- The outlined sewer service areas would effect a relatively small amount of the potential wildlife habitats found within the basin and be a long-term consequence for the area. Only a few archaeological sites would be positively affected by the outlined wetlands/floodplains protection district and the impacts on significant landscape areas would be similar to those discussed in the DeFacto Projection, with few exceptions. The outlined environmental districts would have a positive impact on the amenities of these types of areas. It should be noted that by moderately increasing residential density within the sewered areas, the total amount of land needed for the anticipated growth would be reduced. This would leave more of the remaining potential wildlife habitat and significant landscape areas unaffected by future growth.

- Potential erosion problems could become aggravated in those areas outlined for sewer service, due to the short-run disruption of the landscape during the construction of sewerage facilities, and also due to the potentially increased density of development. The use of sewers in areas with potential flood control problems has not been outlined, since increased development in these areas would mean increased flood control problems. If storm sewers are provided as a corollary action to the installation of sanitary sewers, the potential drainage problems are reduced. However, the use of sanitary sewers alone could adversely affect drainage by permitting increased development and thereby increasing runoff from impervious surfaces. The adoption of wider use of the environmental zoning districts outlined would have a positive effect on erosion, flood control, and drainage by placing constraints on development in these sensitive areas.

- Like in the DeFacto Projection, possible effects on open space would be minimal. Where small areas of open space are located adjacent to outlined sewer service areas, the anticipated development is generally moderate-density residential and therefore would not be incompatible with the open space. The expanded use of environmental zoning districts would enhance open space and recreational opportunitie in these areas.

- The expansion of sewer service areas would allow opportunities for the accommodation of slightly increased levels of manufacturing activities. In several communities, sewer service would be provided for some areas of industrial land, more development could occur which might result in more labor-intensive economic activities. An example might be the difference between a warehouse employing only a half-dozen people and an electrical machinery plant employing a few hundred. However, since industries must pay a proportional share of the capital costs of sewage treatment, the potential costs to industries could act to inhibit plant expansion or location.

- Because of the increased residential density which could be accommodated in the outlined sewer service areas, slightly more multi-family housing could be developed in this alternative. Since the ratio of employment-per-unit is 50 percent greater for multi-family, this alternative could potentially result in more person years of construction activity than the DeFacto Projection. However, this may not be sufficient to offset the somewhat decreased volume of construction over the next twenty years.

- With the increased residential density which could accompany the sewer service areas, and to the extent that less land is used for urban development, a positive effect might result for agriculture because this means that less pressure should be exerted on agricultural lands for conversion to urban uses. While Alternative I does not represent a reversal of the past decline in agricultural activities, it possibly represents a slower rate of encroachment than is anticipated with the DeFacto Projection.

- The use of the outlined sewer service areas would not significantly alter land use patterns in the Lower Charles River Basin. In some instances, however, higher residential densities may be permitted in those areas receiving sewer service. The outlined service areas would likely result in increased development pressure in these areas, with a concomitant reduction in pressure to develop certain unsewered lands. This would mean a shifting of development pressure to those lands provided with sewer service. In planning for growth anticipated over the next twenty years, communities could utilize the sewer service areas to accommodate industrial and commercial development. This would not mean additional land for economic activities but rather would involve a spatial arrangement of economic land to coincide with the sewer service areas. In some proposed areas, environmental zoning districts will place constraints on higher intensity land uses, and would reduce the land available for such development to a very limited extent.

Management Impacts - Alternative I appears to involve moderate management impacts. Existing MSD member communities would have to comply with those MDC requirements identified in the DeFacto Projection. The full implementation of the EMMA Study recommendations could, of course, have some fairly substantial management impacts. These management recommendations are "geared towards giving MDC more independence from Legislature to controls by shifting these controls by member municipalities, but still have MDC retain the State department posture and benefits" (EMMA Study, Vol. 15, p.8-2). These recommendations include: the modification of the 5 member commission structure to a single commissioner responsible for leadership and administration; the freeing of MDC from the need for project-type appropriations by the Legislature to be replaced by overall program authorizations; the creation of a municipal advisory committee to provide local input for program design; establishment of regulations and community coordination; the enlargement of the MSD from 43 member communities to 51 municipalities; internal organizational changes to provide the Commissioner with the ability to plan, implement and manage effectively the proposed plan including the development of subdistricts for operation of each of the proposed service areas; and, finally, increased authority by the MDC over the operation of local sewerage systems.

In the town of Weston the use of a publicly-owned communal septic system would mean the creation of a local authority to operate and maintain the system (or the delegation of this duty by the Selectmen to the local DPW). Since this system would be considered a publicly owned wastewater treatment facility, it is presumed that the prohibition in Title 5 of the State Environmental Code against "the use of a subsurface sewage disposal system by more than one lot..." could be circumvented to allow the use of such a system.

The remaining legal and institutional impacts relate to the non-structural components of Alternative I. These components are generally within the power of local governments. However, for some types of controls, state programs or authority exists for the regulation of these same areas or activities deemed important for water quality management.

The regulation of wetlands through zoning is an allowable use of the zoning power both under the Commonwealth's Zoning Act (Chapter 40A of the General Laws as amended by Chapter 808 of the Acts of 1975) and by case law. Massachusetts, of course, has other regulatory programs dealing with wetlands.

Wetlands Protective Orders for inland wetlands (MGLA c.131, s. 40A) can be imposed by the Department of Environmental Management for "regulating, restricting or prohibiting dredging, filling, removing or otherwise altering or polluting..." fairly large wetland areas. DEM staff and budget constraints also require the focusing of the program in relatively limited areas at this time. However, with respect to the Lower Charles Basin there has been significant activity by DEM in implementing this program. Wetland areas have been restricted in Waltham, Newton, Wellesley, Needham and Dedham, and a public hearing on the restriction program has been held in Weston. The mapping for Natick and Boston has begun, with hearings scheduled for the spring of 1978. This may preclude the need for local action to protect wetlands in order to maintain water quality in many areas identified in Alternative I. Additionally, the coordination of wetland restriction statutes with the Wetlands Protection Act (MGLA c.131, s.40) with a view towards varying degrees of state control based on the significance of the wetland (as is currently being discussed by DEQE's Wetland Program Review Board) would further shift the emphasis towards state regulation of these water quality related critical areas.

Local floodplain zoning is also a permissable use of the zoning power, and is done throughout the state. While there is no directly comparable regulatory authority at the state level, programs such as the Wetlands Restriction Program (for inland and coastal wetlands) and the Department of Environmental Management's Scenic Rivers program could be used to protect the public health, safety and welfare by restricting development in these flood-prone areas, provided the areas in question were properly within the jurisdiction of these programs (i.e., a wetland area as defined in the statute or within 100 yards of the natural bank of a scenic river).

In addition, the Charles River Natural Valley storage areas project presently being carried out by the U.S. Army Corps of Engineers will protect some of the floodplain areas identified in Alternative I through the acquisition of these lands or the acquisition of a restrictive easement for flood management purposes. Local floodplain zoning should therefore be used by communities to augment these programs and protect lands not otherwise protected by these programs.

An alternative to floodplain zoning could be the establishment of stream bank buffers through zoning to preserve and protect the filtration and purification function of land bordering watercourses. The expanded purposes of the new state zoning act which includes the "conservation of natural resources and the prevention of blight and pollution of the environment...", and the clear inclusion of "uses of bodies of water, including watercourses: as an area subject to zoning regulation would indicate that stream buffer districts are an acceptable use of the zoning power.

Stream and river banks could also be protected under the Scenic Rivers Act (MGLA c.21, s. 17B) which allows DEM to apply restrictive orders which regulate, restrict, or prohibit the "dredging, filling, removing, or otherwise altering or polluting" an area which includes the river and 100 yards upland of its natural bank. Until recently,

E. ALTERNATIVE II - MAXIMUM RELIANCE ON NON-SEWERING SOLUTIONS

Description - Alternative II is a comprehensive management program which relies to a maximum degree on the use of non-sewering techniques as a wastewater management solution. Only existing development which has been identified as being problem areas is outlined as sewer service areas, and as was discussed in Concept II above. Other areas are outlined for a program of septic system maintenance. (See Figure 10.)

Future water quality problems can often be avoided by sensitive land management practices. If land is developed in a way that is consistent with the land's capability to support development, then many problems can be avoided. This approach to water quality management is an element in this alternative.

Undeveloped land in the basin that is currently zoned for a land use type or density which conflicts with the environmental capability of the land is outlined for the use of non-structural solutions for the management of water quality problems. Zoning normally regulates the use and density of land development, and the establishment of minimum lot sizes is common technique to determine development density. In order to establish densities of development that do not have adverse impacts on water quality, the natural capacity of the land, the waste disposal facilities, and the water supply should be on the basis for the minimum lot requirement. For this discussion, it can be assumed that a residential density between 43,560 and 21,781 square feet would be utilized in these areas to reflect the environmental capability of the land.

There are other ways in which non-structural solutions could be utilized to accommodate development while not conflicting with the natural capability of the land. The rezoning of these areas to moderate density residential development represents only one example of how non-structural techniques could be employed. Some areas indicated in this alternative for non-structural solutions could possibly be rezoned to permit limited office development or non-processing, warehouse type industrial development with strict site-plan review to regulate the amount and location of impervious surfaces, the maximum building coverage, finished grades, subsurface disposal, etc.

Another element of this management program is a wetland protection and floodplain protection districts in the currently unprotected areas. As was discussed in Alternative I, the use of this element in a water quality management program would maintain the natural functions of wetlands and flood plains.

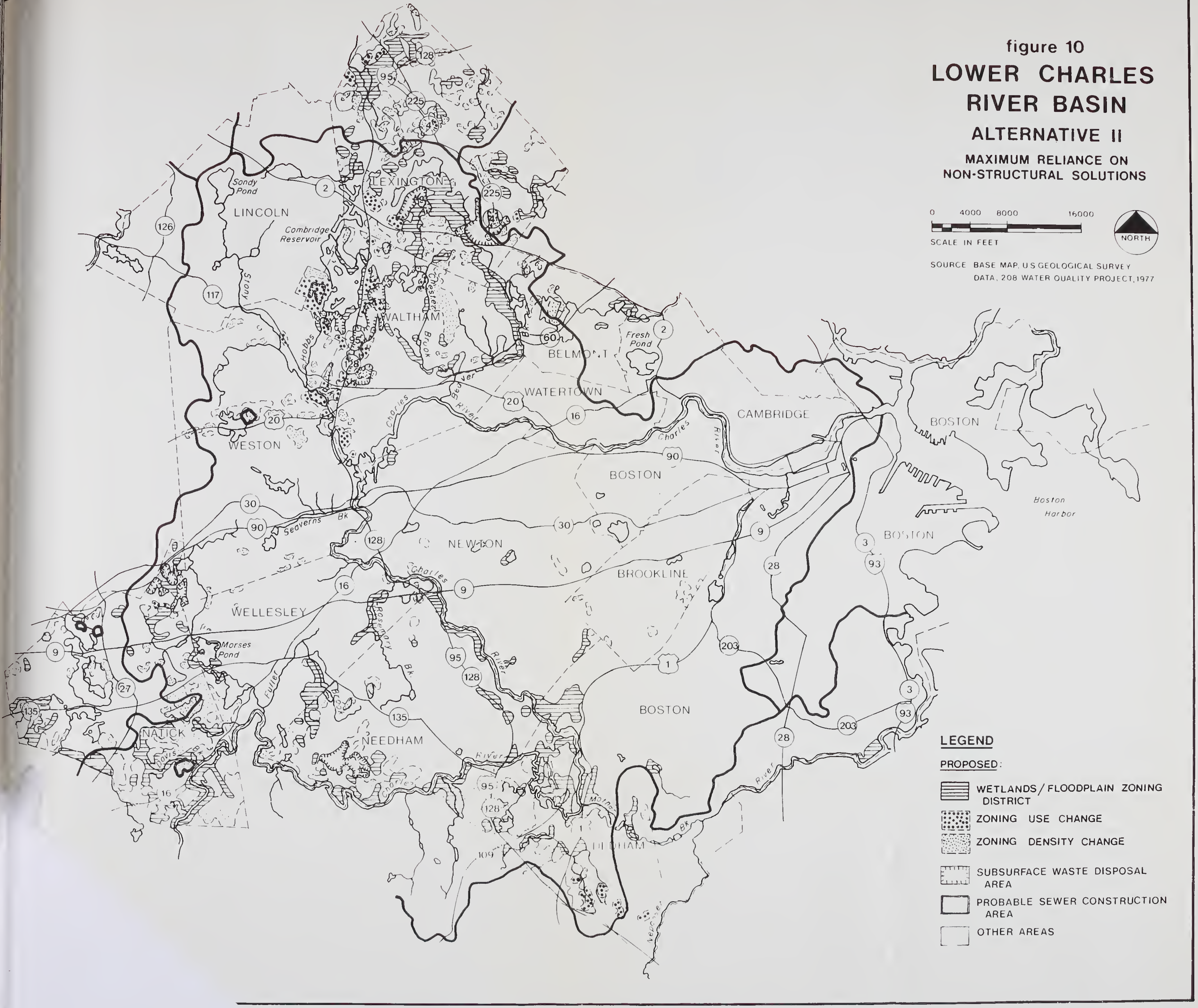
The existing zoning for the remaining areas of the basin remains unchanged in this alternative management program.

figure 10

LOWER CHARLES RIVER BASIN

ALTERNATIVE II

MAXIMUM RELIANCE ON NON-STRUCTURAL SOLUTIONS



SOURCE BASE MAP, U.S. GEOLOGICAL SURVEY
DATA, 208 WATER QUALITY PROJECT, 1977

Impact Assessment - A brief discussion follows of those potential impacts of alternative II which are most significant, and Table 5-3 is included to summarize the possible effects. Appendix D to this report provides a complete discussion of the potential impacts of this alternative management program. It should be noted that most of these impacts could occur in the outerlying suburban communities in the Lower Charles Basin.

- Alternative II does not anticipate an impact on the local tax rate, although reference should be made to the EMMA study for potential costs related to these recommendations. The costs associated with the septic system maintenance programs were outlined generally in Chapter 4.

- While the effects on housing for many areas of the basin would be similar to those discussed in the DeFacto Projection, the effects of the environmental zoning districts would be the same as discussed in Alternative I. Also, an additional negative impact for housing could result in those areas where the permitted density of residential development would be reduced. The larger lot sizes required in these areas would result in increased housing costs and potentially less diversity of housing types. This could be of regional significance in limiting access to housing opportunities in those areas of the basin.

- Since the provision of sewers in this alternative is minimal and limited to currently developed areas of towns, no cost savings for municipal services to these areas would result. Furthermore, the areas of decreased density of residential development would mean a probable increase in service delivery costs within these areas.

- Use of a lower density pattern of development compatible with the environmental capacity of the land would permit more potential infiltration and recharge for the groundwater in these areas. The more minimal use or expansion of sewers than outlined in Alternative I would mean possibly less treated wastewater "exported" from the area and potentially less impact on groundwater.

- In those areas where the intensity of permitted development could be reduced, a reduction in potential erosion problems results. Similarly, potential flood control and drainage problems could be decreased with the use of the lower density development. To the limited extent that sewers are included in this alternative, their effects would be similar to those discussed in Alternative I.

- The effects on wildlife habitats, discussed in Alternative I, would also be an effect of this alternative. The existence of development, even at a lower density pattern, would reduce an area's capacity for wildlife habitats. The impacts on open space would be minimal, although slightly positive. The areas of commercial and industrial land which would be rezoned for lower density residential development would be more compatible when adjacent to existing open space. Additional positive effects would result from the development constraints imposed by the environmental zoning districts which would serve to enhance the recreational potential of these areas.

- Impacts on archaeological and historic sites and areas of significant landscape quality would be minimal, though slightly positive, under Alternative II. Development constraints imposed by the wetlands/floodplains protection district and the rezoning to lower residential density would result in land uses more compatible with these sites.

- Land currently available for industrial and commercial development would be effected by the use of land use regulations which would reduce the intensity of permitted development to moderate or low density residential. This would be a reduction in the total land available for economic use, and therefore opportunities for industrial growth over the next twenty years would be less than in the DeFacto Projection. This type of change in the permitted type of development could mean some existing economic activities would become non-conforming land uses, which would place restrictions on the expansion or rebuilding of these land uses.

- The zoning density reductions outlined would result in some possibly negative effects on the construction industry by reducing the number of housing units which could be accommodated in these rezoned areas. Also the environmental zoning districts would create additional constraints on development, and thereby have a negative effect on total construction activity.

- The potential impacts of Alternative II on agricultural activities would be similar to those discussed with the DeFacto Projection.

- Where the permitted residential densities are decreased through zoning changes, a more land-consumptive pattern of development results. This clearly means that more land is required to accommodate the projected residential growth. Also the permitted land use changes would reduce substantially the total land available for commercial and industrial development. This rezoning could result in an inability to accommodate all of the projected demand for economic activities within some areas of the basin over the next twenty years.

Management Impacts - The legal and institutional impacts of Alternative I appear to be essentially similar to those identified in Alternative with some additional potentially significant impacts relating to land use.

The structural aspects of Alternative II are essentially the same as Alternative I. It does not outline any additional treatment plants. There are fewer new sewer service areas outlined, as only existing problem areas will be sewered. It sewers areas in parts of Natiok and Weston including the use of a communal septic system in Weston. The management impacts of administering such systems would be essentially the same as those identified in Alternative I.

Since Alternative II relies to a minimum degree on the use of sewers as a wastewater management solution the use of non-structural solutions, including zoning changes, would be an important component of this alternative. The proposed zoning changes include zoning density changes, zoning use changes, site plan reviews, wetland protection districts, floodplain districts and stream bank buffers. While the changes themselves would not require new institutions, significant time and resources would be necessary to develop, adopt, administer and enforce these measures.

The management impacts and implications of the non-structural solutions proposed in Alternative II would generally be similar to those identified in Alternative I, particularly with respect to the need to protect wetland and floodplain areas.

As in Alternative I it is recommended that the continued implementation of the Inland Wetland Restriction Program, the possible implementation of the Scenic Rivers Program, the completion of the Natural Valley Storage Program and the acquiring of open space in the Charles River Corridor be carried out in combination with the adoption of local zoning bylaws to adequately protect these wetland and floodplain areas from development which could adversely impact water quality.

Alternative II also recommends zoning density and use changes in many basin communities in order to make the zoning consistent with the natural capabilities of the land to support development. While a number of different zoning techniques could be utilized to accomplish the objective of changing density, ranging from increasing minimum lot sizes, allowing cluster type developments, or adopting strict site plan review requirements in these areas. Whichever technique is employed the method of management would be through utilization of the communities' zoning power.

As noted above, Alternative II outlines the minimum use of sewers as a wastewater management solution with the resultant greater reliance on land management practices in order to enhance, maintain and protect water quality. Local government preference for this alternative as a means of limiting sewering followed by local failure to adopt appropriate non-structural control techniques consistent with this alternative could result in the loss of the opportunity to use non-structural options and the revision of the 208 plan to include more sewering and/or a more significant state role to deal with the water quality problems that may result.

Table 5-3. Impacts of Reliance on Non-Sewering Solutions

mpact Categories / Alternatives	DIRECTION	MAGNITUDE	DURATION	SIGNIFICANCE
Legal and Institutional Implications				
legislative				
institutional		M	L	L/M
Water Quality and Supply Impacts				
ground water	+/-	S	L	L/M
Environmental Impacts				
erosion	-	S	L	L/M
flood control	+/-	S	L	L/M
drainage	-	S	L	L/M
recharge	+/-	S	L	L/M
wildlife	-	S	L	L
air quality	O			
Social Impacts				
housing	-	S	L	L/R
recreation and open space	+	S	L	L
archeological and historical	+	S	L	R/N
aesthetic	+	S	L	L
Economic/Employment Impacts				
water quality related employment	O			
manufacturing	-	M	L	L/M
construction	-	M	L	L/M
agriculture	-	S	L	L
Governmental Impacts				
taxes and assessed valuation	-	S	L	L
induced costs or municipal service requirements	-	S	L	L
Land Use Impacts				
population		S	L	L/M
residential land use		S	L	L
commercial land use		M	L	L
industrial land use		M	L	L
transportation	-	M	L	M

nd:

ction = += positive impact
-= negative impact
O= negligible impact

itude = S= slight impact
M= moderate impact
E= extensive impact

duration = L= long-term impact
S= short-term impact

significance = L= local significance
M= multi-local significance
R= regional significance
N= national significance

Chapter 6

Institutional Framework: Changing to Meet Present and Future Needs

CHAPTER 6 INSTITUTIONAL FRAMEWORK: CHANGING TO MEET PRESENT AND FUTURE NEEDS

In this chapter you will find:

A. A description of the types of water quality management authorities required by Section 208.

B. A description of the management implications for local governments of the alternative solutions.

C. A description of the management implications for multi-local governments (including the MDC) of the alternative solutions.

D. A summary of areawide management alternatives.

E. An identification of existing and possible future state programs important for 208 water quality management.

F. An identification of federal programs which could assist in implementing water quality solutions.

A. MEETING FEDERAL REQUIREMENTS

Previous chapters have identified numerous existing and potential water pollution problems facing basin communities. A broad range of alternative solutions has been presented for consideration by municipalities within the watershed. While the description of some of the alternative solutions has included the appropriate legal and institutional authorities responsible for implementation, this is not enough. We must now integrate the various alternatives into a comprehensive, areawide program designed to bring all levels of governmental authority to bear in a coordinated, areawide management structure.

The integration of those management roles required by Section 208(c)(2) of the Federal Water Pollution Control Act Amendments of 1972 must be set forth in the 208 plan. Therefore, this chapter is concerned with the implication of proposed solutions for the establishment of a coordinated and cohesive wastewater management program for the entire study area.

In reviewing the following discussion it is important to note that once an areawide water quality management plan is developed, including designation of specific management agencies, and approval is given by state and federal authorities:

- No grants for construction of any publicly-owned treatment works under Section 201 can be made except to a designated agency, and for works in conformity with the 208 plan;

- All permits issued under the National Pollutant Discharge Elimination System (Section 402) must be in conformance with the areawide MAPC Water Quality (208) Plan.

Federal Requirements for an Areawide Water Quality Management Program under Section 208*

- to carry out appropriate portions of an areawide waste treatment management plan developed under subsection (b) of section 208, Subsection (b) contains the general plan requirements including the identification of treatment works needed for a twenty year period, the establishment of processes to identify various sources of pollution; provision for control or treatment of all point and non-point sources of pollution, on an areawide basis if practicable; the regulation of the location, modification and construction of any facilities which may result in a discharge; and assurance that industrial or commercial wastes discharged into treatment works meet applicable pretreatment requirements;
- to effectively manage waste treatment works and related facilities serving the area in conformance with the 208 plan;
- to design and construct new works, and to operate and maintain new and existing works as required by the 208 plan, either directly or by contract;
- to accept and utilize grants, or other funds from any source, for waste treatment management purposes;
- to raise revenues, including the assessment of waste treatment charges;
- to incur short and long-term indebtedness;
- to assure in implementation of a 208 plan that each participating community pay its proportionate share of treatment costs;
- to refuse to receive any wastes from any municipality or subdivision thereof, which does not comply with any provisions of the 208 plan; and
- to accept for treatment industrial wastes.

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*The authority required for management systems under Section 208 is described in detail, with relevant analysis, in a preliminary MAPC Water Quality Project report entitled "208 Management Alternatives".

Clearly, the management system identified by the MAPC 208 plan must include a wide range of governmental functions. The management and control of wastewater treatment works and the regulation of point sources of discharge are two related aspects of the system. In addition, processes must be established and provisions made for the identification and control of non-point sources of pollution. It should be apparent from the discussion of possible solutions to non-point sources of pollution that their control often involves legal authority and governmental institutions not usually directed to wastewater management.

While the possible control programs for non-point sources of pollution are as diverse as the sources themselves, EPA has recently provided some guidance on the necessary components of an approvable non-point source control program.[1] A regulatory program must include the following:

> "(a) Authority to control the problem which the program addresses (i.e., an activity, pollutant, or geographical area).
>
> (b) Authority to require the application of Best Management Practices and their periodic revision.
>
> (c) Monitoring and/or inspection authority.
>
> (d) Authority to implement the chosen control tool (i.e., permits, licenses, contracts, etc.).
>
> (e) Enforcement authority.
>
> (f) A designated management agency responsible for implementing the regulatory program with:
>
>> expertise in the subject matter area to be controlled
>>
>> adequate staff
>>
>> adequate funding
>>
>> the relevant authorities pursuant to Section 208(c)(2) and 40 CFR 131.11(o)."

A proposed program could be considered deficient if it has insufficient legal authority, inadequate rules and regulations, inadequate resources or an inadequate management agency. The regulatory program could utilize various types of control tools such as permits, licenses, contracts, notification, bonding, leases, plans and various management techniques.

Non-regulatory programs to control non-point sources may be approvable if the following conditions are met:

- provision of an effective educational program to inform the affected public of the requirements;
- provision of adequate technical assistance and financial assistance;
- identification of Best Management Practices;
- agreement of schedule of milestones, such as implementation, monitoring and program evaluation;
- agreement to reporting system (at least annual) to the Regional Administrator on progress made in implementation.

Non-regulatory programs which do not provide additional educational, technical or financial assistance or utilize techniques and institutions which have not been successful in the past shall not be acceptable.

It should be remembered that while EPA regulations contain a clearly stated preference for point and non-point source management on a statewide and/or areawide basis,[2] there is no prohibition against locally administered regulatory programs (particularly for non-point sources), and local government agencies acting as designated management agencies within an areawide management system. The EPA is also requiring that each management agency identified in the 208 plan which will carry out tasks clearly identified in the plan must be identified in a management agency implementation statement and where new or incremental responsibilities are proposed there must be a statement of management agency willingness to proceed provided either by the designated management agency or by the water quality management planning agency.[3] What follows is a description of the government entities which could implement the solutions identified in this report. While some solutions can only be implemented by one level of government or by one government agency, others could be implemented at various levels of government or would require some action by more than one level of government.

B. MANAGEMENT IMPLICATIONS FOR LOCAL GOVERNMENTS

At the local level, departments, boards and commissions must begin to consider their powers and duties in terms of water quality management needs of the locality and the region. Of course, questions of adequate funding, administrative effectiveness, political accountability and economic efficiency will be considered by local governments in assessing their potential role in water quality management. The desirability and political feasibility of the controls outlined in this report must be evaluated in terms of water quality, and with respect to other social and economic needs of the community.

As important as considering the role of each town board in a wastewater management system is the evaluation of the need for increased cooperation between local departments, boards and commissions. Growth policy statements from many study area communities indicate the need for better intra-municipal coordination. The formation of Growth Policy Committees was itself a step in this direction. Communities should consider either the continued existence of this type of committee or the formal establishment of some other coordination procedure. For example, some communities have instituted monthly meetings of board and commission chairmen and department heads in order to discuss issues of common concern, and to consider all aspects of long range community planning. Because of the diversity of water quality related authority at the local level some type of coordination procedure appears necessary for effective local water quality management. It also offers clear advantages for all aspects of efficient municipal management.

The need for more professional, full-time administration of town government was also expressed as a concern in some growth policy statements. To the extent that wastewater management implications for local government support the argument for more professional staff, communities should consider how this need can be best met. Increased technical assistance from the regional level or a more limited inter-municipal approach to some municipal functions are two alternatives to the hiring of full-time, profesional staff by individual communities.

The following discussion focuses on the management implications of the solutions proposed in this report for local government. Local governments must now evaluate these proposals and their own role in the plan's implementation.

Land Use - As was indicated earlier, many water quality problems can be addressed without the construction of sewer lines and treatment facilities. The control of land use, including controlling and directing the growth of a community, can prevent land disturbing activities which may result in the degradation of water quality, as well as prevent the need for expensive structural solutions to water pollution problems. It is recognized that some land use controls, such as zoning techniques, will be of less value in combating pollution in the highly developed and largely sewered communities of the Lower Charles Basin than in communities with large amounts of undeveloped land.

In Massachusetts, local governments exercise the greatest control over land use through zoning, subdivision regulations, health regulations and the permitting of activities in wetlands. In this local arsenal of control techniques, zoning must be considered preeminent in its ability to control growth and prevent haphazard development. Zoning techniques, such as wetland, floodplain, aquifer recharge, stream buffer, watershed protection, and water resource protection districts as well as cluster, PUD and site development regulations and site plan reviews, that control various aspects of land development which tend to have a negative impact on water quality, have been set out and explained in Appendix C. In terms of management implications, local communities should consider the impact that the adoption of some of these proposals would have upon the administration of municipal zoning by-laws. It should be noted that Chapter 808 of the Acts of 1975 amended Chapter 40A of the General Laws, the Zoning Act. While the new act does not attempt to limit the purposes of zoning, it does suggest objectives for which zoning could be established. These include the conservation of health; securing safety from flood and other dangers; the prevention of the overcrowding of land to avoid undue concentration of population; facilitating the adequate provision of water supply, drainage, sewerage, open space and other public requirements; the conservation of natural resources and the prevention of blight and pollution of the environment; and the encouragement of the most appropriate use of land, including consideration of the recommendations of the master plan, if any, adopted by the planning board and the comprehensive plan, if any, of the regional planning agency.[4] In light of these expanded objectives, the establishment of zoning districts for the protection of wetland, floodplains, aquifer recharge areas, stream buffers and districts for watershed protection and water resource protection should be considered a legitimate use of the zoning power. While care must be taken in the drafting of such by-laws to prevent privately owned land from being deprived of all practical values,[5] ordinances can be drafted which consider the natural characteristics of the land (drainage and recharge, for example), and the effect which different types of development have on this natural character. Such ordinances may require increased technical expertise in their drafting and their administration, particularly when a more detailed data base is required. The procedural requirements of Chapter 808 of the Acts of 1975 should be complied with in the adoption of any new zoning by-law, effective January 1, 1976.

In adopting Chapter 808, the legislature did not take advantage of the opportunity to limit large lot zoning in the cities and towns. Large lot zoning remains a generally acceptable practice in Massachusetts. The power of communities to adopt one acre[6] or, in some cases, two acre zoning,[7] when the environmental and public health considerations require it, has been upheld by the Supreme Judicial Court. As long as restrictions are not adopted solely to act as a barrier "against the influx of thrifty and respectable citizens who desire to live there...[8], or for purely aesthetic reasons such as keeping land in its natural state"[9], they would be permissible.

Appendix C describes the use of cluster developments and planned unit developments in permitting the development of land while protecting environmentally sensitive areas. These types of zoning have not been utilized extensively in the basin.

Chapter 808 specifically authorizes cluster and PUD provisions through the issuance of special permits.[10] It also authorizes increases in density or intensity of use where the developer agrees to conditions which benefit the community, and allows the special permit granting authority to adopt rules prescribing "the size, form, contents, style and number of copies of plans and specifications and the procedures for the submission and approval of such permits."[11] A number of different authorities are not allowed to act as the "special permit granting authority", including the board of selectmen, city council, board of appeals, planning board or zoning administrator. This offers communities the opportunity to consolidate the authority for granting various permits and approving plans, such as the approval of subdivision plans, in one body, the planning board. This step towards the streamlining of permitting procedures should be utilized by communities seeking more coordinated and efficient local administration of governmental functions, and could result in better local water quality management.

While subdivision regulations also offer the community some opportunities for dealing with development which could adversely affect water quality, there are a number of caveats which should be noted. The Subdivision Control Law, the enabling statute for local subdivision regulations, was enacted "for the purpose of protecting the safety, convenience and welfare of the inhabitants of the cities and towns...by regulating the laying out and construction of ways in subdivisions...and ensuring sanitary conditions in subdivisions and in proper cases parks and open areas".[12] This legislative statement of purpose should be strictly construed. "The only purposes recognized are to provide suitable ways for access furnished with appropriate municipal utilities, and to secure sanitary conditions."[13] The extent to which subdivision regulations can be used to protect water quality, particularly off-site water quality, is an issue which has not been directly addressed by the courts. While the danger of pollution to adjacent wetlands from surface water runoff and the seepage of sewage through the soil structure and the resultant menace to marine life have been recognized as "matters of legitimate public concern"[14], the validity of subdivision regulations designed to guard against these dangers has yet to be determined. Regulations ensuring adequate drainage of the locus are within the scope of the law[15], even when it involves the "natural""drainage of the locus.[16] Whether the drainage of adjacent areas outside the subdivisions is also proper concern of the planning board is again an issue that has not been decided.[17] A bill introduced in the past legislative session, (House No. 3067) proposing comprehensive amendments to the Subdivision Control Law states, in the purposes section (Section 2), that "the powers under this chapter shall be exercised with due regard for... water quality" and "securing the protection of the natural and man-made environment, including the prevention of sedimentation and erosion..." This bill is a step in the right direction toward clarifying this role of the planning board in regulating development which could adversely affect both on-site and off-site water quality.

While there are many unresolved questions as to the scope of subdivision regulations dealing with surface runoff, drainage and resultant pollutant problems, it is clear that "the determination of all health questions with respect to the disposal of sewage in a subdivision which will not be connected to a municipal sewer is vested exclusively in the board of health."[18] Planning boards may defer to boards of health on issues relating to subsurface disposal. This necessitates a very strong role for local boards of health in preventing adverse water quality impacts from subdivision development. However, it also raises significant questions as to the relationship between local subdivision rules and regulations and local board of health regulations.

Language in a recent subdivision case indicates that a board of health would be acting prematurely and unreasonably if it were to take any action with respect to Article XI (the predecessor of Title 5) other than to require the planning board to endorse a condition on the definitive plan to the effect that no dwelling shall be built on any lot without first securing from the board of health the disposal works construction permit.[19]

While the court's reasoning as to the inability to determine the suitability of the lot for subsurface sewage disposal until the determination as to the placement of the system is made has considerable merit, the result is the possible approval of subdivisions with lots unsuitable for sewage disposal, the lot owner being stuck with a lot that doesn't meet the minimum requirements, and, often, a variance being granted by the local board of health in order to mitigate the hardship on the unsuspecting lot owner (the lot owner may, in such a situation, have a cause of action against the developer under the State's Consumer Protection Statute, Chapter 93A of the General Laws). Clearly, such a situation is unworkable and some action at the state level should be taken to remedy it.

The subdivision plan approval process could, to some extent, be streamlined by local government under the existing enabling authority. The holding of a joint or concurrent hearing by several boards, such as the planning board and board of health could improve the process somewhat. However, there are existing statutory limitations to the extent of this streamlining. Clearly, any significant improvement in the subdivision plan review and approval process must emanate from the legislature.

The streamlining of procedures in the subdivision approval process is an area currently receiving some attention at the state level. The bill to amend the Subdivision Control Law previously mentioned (House 3067) attempts to provide this streamlining by providing for joint public hearing on a definitive plan by the planning board, conservation commission and board of health, and other state, regional and local boards, commissions or agencies deemed to have an interest in the proposed subdivision. These boards, commissions and agencies must then take any action on the plan within a specified time period (which varies with the agency involved) from the date of the public hearing. These provisions are designed to shorten the time period it takes to get subdivision plan approval and to simplify the procedures for developers seeking this approval.

The bill also provides for a pre-application review by the planning board, board of health and conservation commission. At this pre-application review stage, local boards can also notify the applicant as to those portions of the proposed development likely to be approved, approved with modifications or conditions, or disapproved. Before the joint public hearing, a more complete and inclusive set of data, plans and specifications would have to be submitted - much like the present requirements governing the submission of a definitive plan. These new procedures would get the three key municipal bodies involved in reviewing local land development together at an early point in the subdivision review process when they would jointly benefit from their respective backgrounds and points of view. A review of all relevant aspects of a proposed development at one time would also encourage more citizen involvement in local growth and development decisions.

This bill also provides for regional planning agency review of subdivisions of "regional impact". This provision could facilitate the monitoring of land uses which degrade water quality, and which may be inconsistent with 208 plan recommendations, as well as offering the regional planning agency the opportunity to comment and provide assistance during the plan approval stage. House 3067 is, hopefully, the beginning of a process which will result in more effective and efficient procedures for dealing with development.

Public Health - In addition to its authority over land use, local government exercises considerable authority with respect to public health. Local boards of health are charged with enforcement of Title 5 of the State Environmental Code, and can impose more stringent regulations when local conditions require them.[20] They may make and enforce regulations relative to house drainage and connection with common sewers.[21] They assign sites and monitor the operation of any "sanitary landfill, a refuse transfer station, a refuse incinerator, a refuse composting plant, a dumping ground for refuse or any other works for treating or disposing of refuse."[22]

They may examine and destroy, remove or prevent nuisances, including those which affect the public water supply.[23] They regulate private and semi-private water supplies.[24] They may assign locations where offensive trades or employment which may result in a nuisance, be harmful to the inhabitants or dangerous to the public health can only be carried on,[25] and they make "reasonable health regulations", including regulations on sewage disposal and regulations necessary to remove or prevent nuisances.[26] As has been noted previously, local boards of health also play an important role in the subdivision approval process.

Considering the scope of their authority, local boards of health can play a significant role in the wastewater management system. However, the extent to which they can effectively and efficiently carry out their duties in a manner which will further water quality goals is unclear. Insufficient resources and a general unwillingness to take steps to promote water quality could be fatal to local implementation of a water quality management plan.

Inspection and maintenance programs outlined in Appendix C will clearly put a fiscal and administrative burden on local boards of health. While it must be remembered that such a program could alleviate the need for more expensive treatment facilities in some situations, and that some elements of an inspection and maintenance program could be eligible for 201 funding (i.e., the vehicles and associated capital equipment required for servicing of the systems);[27] nevertheless, the impact on local boards of health could be substantial. Full-time staff would be required, and technical expertise in the installation, inspection and maintenance of subsurface disposal systems would be a necessity. (In the Lower Charles Basin, communities committed to sewering all or most development, major inspection and maintenance programs will not be necessary. Smaller scale programs aimed as preventing water quality problems in pockets of unsewered development are suggested. The information below may be adapted, as appropriate, by local health officials.)

Although boards of health have clear authority to order cleaning and repairing of systems, that authority is not restricted to failing or nuisance systems. Rather, local boards can adopt reasonable regulations to prevent nuisances such as mandatory maintenance programs that include registration, periodic inspection and cleaning when warranted. Two provisions of Title 5 are applicable to mandatory maintenance programs. The first states that "septic tanks should be inspected and cleaned at least annually" (6.16), while the second provision requires that every owner of a system must "keep the sewers and disposal systems in proper operational condition and shall have such works cleaned or repaired at such times as ordered by the board of health" (2.19). Clear policy preference is expressed, therefore, for annual inspection and cleaning, and furthermore, there is clear authority in Title 5 to order cleaning and repairing of the system.

It should be noted that the authority of local boards of health to regulate on-lot waste disposal does not spring solely from Chapter 21A of Section 13 of the General Laws (or Chapter 111 Section 127A of Section 127, previous enabling statutes on this issue). Rather, local boards also have the authority under Chapter 111 Section 31 to adopt reasonable health regulations, and under Chapter 111 Section 122 to issue regulations to prevent nuisances. In adopting regulations local boards of health need not cite the specific enabling authority for such regulations, and in fact, the regulations need not be based on only one section of the General Laws.[28]

Therefore, a community could adopt, through board of health regulations, a mandatory septic tank maintenance program requiring registration, periodic inspection, and cleaning under the authority of some or all of the enabling statutes cited above. As long as regulations were reasonable, and could be deemed necessary to prevent the possible occurrences of nuisance conditions they would be valid. It is an often-stated legal principle that laws (or regulations) passed in the legitimate exercise of the police power are not obnoxious to constitutional provisions merely because they do not provide compensation to the person who is inconvenienced by them. That individual is presumed to be rewarded by the common benefits secured.[29] Indeed, most health regulations and many other regulatory actions based on the police power impose compliance costs and affirmative action requirements on the individual.[30]

Preventive inspections have been held to be clearly authorized by the sanitary code itself.[31] The same reasoning would clearly apply to Title 5 of the State Environmental Code, especially considering the provisions of Title 5 set forth above. However, the Supreme Court has held that Fourth Amendment privileges against unreasonable search and seizures do apply to such preventive inspection programs,[32] when the homeowner does not consent to the inspection. Therefore, search warrants must be obtained before such inspections can be made. However, the "probable cause" standard for obtaining such a warrant could probably be met by showing the need for periodic inspection of certain facilities, in this case, septic tanks. There would be no need to show cause to believe that substandard conditions dangerous to the public are actually being maintained.

The recent DEQE decisions to leave the permitting of subsurface disposal systems between 2,000 and 15,000 gal/day to local boards of health because of budget and manpower constraints also has significant implications for local health boards. The uncertainty of state involvement in an area critical to health, well-being and environmental quality should generate discussion at the community level on the role of the board of health in providing similar municipal services. An inter-municipal approach to carry out public health responsibilities should be seriously considered by communities in this basin which are not already involved in a regional health district. (See below.)

The role of the local board of health in assigning landfill sites and monitoring has been previously mentioned. As noted in Appendix C pollution problems caused by landfills are generally due to poor siting and poor operating practices. The inability of the DEQE to effectively monitor landfills has also been noted. While stepped up surveillance of town landfills by the board of health is a desired objective, it is recognized that a community's solid waste problem involves much more than just water pollution. It may be unrealistic to expect a community to vigorously enforce state regulations against itself when such enforcement results not only in increased cost to the community but also may result in an unsolvable solid waste disposal problem.

Adequate facilities are generally not available. However, local boards of health can be active in educating local officials and citizens to the health and environmental problems of inadequate landfills. They can also be active in generating discussion at the community level on regional solid waste disposal alternatives and can point out the need for state and federal programs to provide financial assistance to make the necessary improvements to existing landfills.

Additionally, local health boards could utilize their authority to assign locations where offensive trades can only be carried on, and their authority to prevent the occurrence of nuisance conditions, to identify those areas where the storing of hazardous materials and industrial stockpiles have the potential of degrading water quality or threaten underground water supplies or potential water supplies, and to adopt regulations prohibiting those activities. While local boards of health may not assign any part of a city or town as a suitable place for an offensive trade or employment if such use is prohibited by a zoning regulation,[33] they could presumably prohibit an offensive trade or employment from an area where the zoning would otherwise allow it.[34]

Conservation Commissions - Local conservation commissions are established "for promotion and development of the natural resources and for the protection of watershed resources" of the city or town. They may develop conservation and passive outdoor recreation plans for the community, and may acquire by gift, purchase, grant, bequest, devise, lease or otherwise the fee in land or water rights for conservation purposes, or any lesser interest, development right, easement, covenant, or other contractual right in such land. They may also take land by eminent domain.[35] The state's Self-Help Act, HUD's Open Space Land Program and BOR's Land and Water Conservation

Program are sources of funding for acquiring such interests in land or water.

Under the Wetlands Protection Act, conservation commissions also exercise regulatory authority over the removing, filling, dredging or altering of "any bank, beach, dune, flat, marsh, meadow or swamp bordering on the ocean or on any existing creek, river, stream, pond or lake or any land under said waters or any land subject to tidal action, coastal storm flowage or flooding."[36] The scope of this authority, therefore, covers most land that is periodically wet. Additionally, the word "alter" is broadly construed by regulation to include:

- "The changing of pre-existing drainage characteristics, flushing characteristics, salinity distribution, sedimentation patterns, flow patterns and flood storage retention areas;

- "The drainage or disturbance of the water level or water table;

- "The dumping, discharging or filling with any materials -- which could degrade water quality;

- "The changing of water temperature, biochemical oxygen demand (BOD), and other natural characteristics of the receiving water;

- "Changes which may adversely affect shellfish or fisheries."[37]

Therefore, any activity which would result in any of the changes noted above in lands or waters covered by the act could be considered subject to the provisions of the act. By being able to issue orders of conditions or to prohibit activities which could result in the types of alterations listed above it could be said that conservation commissions have much of the required authority to "regulate the location, modification or construction of any facilities within such area which may result in any discharge in such area,"[38] at least with respect to many types of non-point source discharges. (Point source discharges would, of course, fall under the purview of the NPDES program.) For this reason alone, conservation commissions must be considered an integral part of any wastewater management system. When one also considers their responsibility for developing conservation plans and their ability to acquire land for conservation purposes, their role in the 208 management system in preventing development which could degrade water quality becomes even more important. It should also be noted that BOR has agreed to "encourage states in their State Comprehensive Outdoor Recreation Plan (SCORP) process to include public outdoor recreation elements developed in regional water quality management plans in establishing statewide priorities."[39] Therefore, it is suggested that local conservation commissions not only exercise their authority under the Wetlands Protection Act with a view towards preventing the degradation of surface and groundwater quality, but that they also develop or amend,. if necessary, their conservation plans to ensure consistency with, and furtherance of 208 plans and plan recommendations.

Septage Management - Because the Lower Charles Basin is generally sewered, septage management does not present a significant problem. The septage generated is generally disposed of into the MDC system. Therefore, much of the information on the legal and institutional implications of septage management has been omitted from this report. Those interested in learning more about the issue are referred to the earlier basin reports and to a forthcoming MAPC-208 "Regional Septage Treatment and Disposal Alternatives Report."

The MDC currently allows non-MSD communities to discharge septage into their system provided a contract has been executed between the MDC and the community seeking disposal privileges. The Lower Charles Basin communities of Lincoln and Weston currently have such an arrangement. The MDC assesses a yearly fee based on the population of the non-member community. The fee has recently been raised to $1.65 per capita, a rate that is still a fraction of the per capita costs to member communities (which also receive sewer service) and far less than the likely costs for the non-member communities to provide for septage disposal outside of the MSD.

Procedurally, the current process by which non-member communities dispose of septage to the MSD is complex. In addition to the required contract with the MDC, permission must be granted from the local authority having control over the municipal sewer leading into the MDC system. The municipality granting this privilege usually charges the pumper for each discharge. The pumper must also obtain a permit from the community where the septage is pumped, according to S. 31A Chapter 111 of the General Laws and Title 5 of the State Environmental Code. A fee for each permit may be charged by the local Board of Health. There are, therefore, at least two local agencies, one private contractor, the MDC and, of course, the local homeowner, involved in each instance of a septage discharge to the MSD system. The difficulties in monitoring such a system are obvious.

In a decision which they have recently reaffirmed, the MDC commissioners have notified all non-member communities that they will have to find some alternative means of septage disposal after December 31, 1979. Additionally, MDC has notified non-member communities discharging septage to the system that they must file an "implementation schedule" with the MDC by September 30, 1977 with progress and status reports to be filed each following January and June. Unless these reports are received, indicating progress towards meeting the December 31, 1979 final termination date,then no renewal contract will be issued for the period beginning July 1, 1978. There is general compliance with this requirement by the non-member communities currently discharging to the system.

Publicly-Owned Treatment Works - Section 208 requires the designation of management agencies with authority to: effectively manage waste treatment works; design, construct, operate and maintain new and existing works; accept and utilize grants; raise revenues; incur short and long-term indebtedness; assure that each participating community pay its proportionate share of treatment costs; refuse to receive any wastes from a non-complying municipality; accept for treatment industrial wastes.[40] Since much of the required 208 management agency authority relates to operation of sewage treatment facilities, those local government entities controlling municipal treatment facilities, be they sewer commissions or boards,[41] or the board of selectmen acting as the sewer commission or board and delegating its authority to a local sewer or public works department,[42] will be important elements of any management system.

Chapter 83, section of the General Laws authorizes a city or town to:

> "lay out, construct, maintain and operate a system of common sewers and main drains...as they adjudge necessary for the public convenience or the public health...Such works for sewage treatment and disposal may include any wastewater treatment facility for treating, neutralizing or stabilizing sewage including treatment or disposal plants; the necessary intercepting, outfall and outlet sewers; pumping stations integral to such facilities; and equipment and appurtenance related to the foregoing."

The communities in this basin, therefore, have the required authority, individually, to "design and construct, operate and maintain new and existing works." It must be remembered, however, that for communities connected to the MDC, any consideration of their legal authority over sewers and treatment works must be viewed in relation to the legal authority of the MDC. Generally, communities maintain ownership and control over the local collection systems which connect with MDC interceptors. The scope of the legal authority of the MDC is discussed in more detail in a subsequent section of this chapter. All of the sewered communities covered in this report are connected to the MDC system.

An officer or department, of any city or town or regional district is authorized to accept grants or gifts of funds from the federal government, a charitable foundation, a private corporation, or an individual pursuant to the provisions of Chapter 44, section 53A of the General Laws. The utilization of sums allotted and paid by the commonwealth is controlled by section 53B of Chapter 44. Chapter 74 of the Acts of 1945 further enables cities, towns, districts and some counties (not Suffolk) to secure the benefits provided by the federal government to assist them in public works projects, including the acceptance of grants and the ability to incur long and short-term debt related to such projects. Additionally, Chapter 44, sections 7 and 8 of the General Laws deals with the municipal financing of sewer construction, and the incurring of debt for such construction. Finally, under Chapter 21, section 30A of the General Laws (The Massachusetts Clean Waters Act), a city, town, special district, the MDC, or other existing governmental units may be authorized by the Division of Water Pollution Control to apply for, accept and receive financial assistance from the commonwealth for the planning and construction of abatement facilities. After a plan for the abatement of water pollution has been approved by the division, the division may authorize the governmental units mentioned above (and pollution abatement districts) to apply for grants from the U. S. Government for such projects. (c. 21 MGL s. 33).

Generally, it can be said that communities in the basin, with respect to the construction and operation of waste treatment works, have the required authority to "accept and utilize grants" and "incur short and long-term indebtedness".

Communities in the basin have the authority to "raise revenues" through their ability to assess local taxes,[43] accept donations, gifts and grants (see discussion above), and by the power to assess costs for the construction and use of municipal services, in this case wastewater treatment facilities.[44]

Communities should, of course, be aware of their responsibility, in constructing wastewater treatment facilities with federal funds under section 201 of the Act (P. L. 92-500), to adopt systems of user charges for all users of the facilities and industrial cost recovery for industrial users of the facilities as well as a sewer use ordinance meeting federal requirements. EPA regulations require the withholding of a portion of federal grant funds until these requirements are provided by the municipalities and approved by EPA.[45]

All 201 grants awarded after March 1, 1973, for the design or construction of treatment facilities require that "an approvable plan and schedule of implementation have been developed for a system of user charges to assure that each recipient of waste treatment services within the applicant's service area will pay its proportionate share of the costs of operation and maintenance (including replacement) of all waste treatment service provided by the applicant..."[46] In distributing the proportionate share of O&M (operation and maintenance) costs to each user of the system, factors such as volume, strength and delivery flow rate characteristics should be considered. The use of ad valorem property taxes to pay for O&M costs is currently not allowed. While operation and maintenance costs have to be recovered by a user charge system, such a system could also include capital and debt service costs, but is not required to do so. In addition to payment of O&M costs for local 201-funded facilities, MDC communities covered in this report must also pay a portion of the O&M costs for MDC facilities. These costs have been apportioned to all MDC sewerage district members (now 43) according to a formula developed for the MDC.

> "The user charge system may be designed to distribute costs to all users as a single class, or, alternatively, two or more classes of users may be identified, with each user paying the proportional share of the operation and maintenance costs assigned to that class. For the first year, operation and maintenance costs are to be based on experience in similar facilities or upon some other method that can be shown to be rational. The user charges must be reviewed annually and revised periodically to ensure fair and adequate cost recovery. The user charge system must be incorporated in a municipal ordinance or other legislative enactment. If the project is a regional one, each participating municipality must adopt a system of user charges.
>
> "Quantity discounts are not allowed, and a user charge system based upon a percentage of the water bill can be used only if the charge for water is based upon a constant cost per unit of consumption. A surcharge may be levied when the concentrations of pollutants such as BOD and SS discharged by a user exceed the normal range of concentrations found in domestic wastewater. Each municipality must maintain records and documents which demonstrate compliance with the above requirements.
>
> "EPA will make no payments in excess of 50 percent of the total construction grant amount unless a municipality has initiated work on a user charge system and can demonstrate that work is progressing satisfactorily. No more than 80 percent will be paid until such a system is approved by EPA, and evidence is given that the charges will be implemented."[47]

EPA also requires, for 201 grants awarded after March 1, 1973, that each industrial user of the treatment facilities make payments over a period of years (30 years or the useful life of the facilities, whichever is less). Such payments must equal the industry's allocated share of the 201 grant. The determination of this share must consider all factors which significantly influence the cost of the treatment works, including such factors as strength, volume, and delivery flow rate characteristics.

> "At a minimum, an industry's share must be proportional to its flow in relation to the design flow capacity of the facilities. If there is a substantial change in the strength, volume or delivery flow rate characteristics of an industrial user's waste discharge, such share must be adjusted accordingly. If the treatment facilities are subsequently expanded or upgraded, each existing industrial user's share must be respectively readjusted again. An industrial user's share must include only that portion of the construction grant allocable to that user or to capacity firmly committed to that user; it must not include an interest component."[48]

Payments must be made at least annually with the first payment due not later than one year after the industry begins to use the facilities.

An industrial user is "any non-governmental user of publicly owned treatment works identified in the Standard Industrial Classification Manual, 1972, Office of Management and Budget, as amended and supplemented under the following divisions:

(a) Division A. Agriculture, Forestry and Fishing

(b) Division B. Mining

(c) Division D. Manufacturing

(d) Division E. Transportation, Communications, Electric, Gas, and Sanitary Services

(e) Division I. Services"[49]

EPA further requires that each "significant industrial user" (one that will contribute greater than 10 percent of the design flow or design pollutant loading of the treatment works) sign a letter of intent agreeing to pay the portion of the federal grant allocable to the treatment of its wastes. These letters of intent are required prior to the award of a grant for either the design or construction of the treatment works.[50]

The municipality retains 50% of the amounts recovered from industrial users. The other 50%, including any interest earned on it, is returned annually to the U. S. Treasury. Eighty percent of the amount retained by the municipality (including interest earned on it) can only be used for the eligible costs of the expansion or reconstruction of treatment works associated with the project and necessary to meet the requirements of the Act (P. L. 92-500). These retained amounts must be invested in:

- Obligations of the U. S. Government,
- Obligations guaranteed as to principal and interest by the U. S. Government or any agency thereof, or
- Accounts fully collateralized by obligations of the U. S. Government or, by obligations fully guaranteed as to principal and interest by the U. S. Government or any agency thereof.

The remainder of the retained amounts may be used as the municipality sees fit.[51] No more than 50 percent of the construction grant (step 3) will be paid unless the municipality has submitted evidence of the timely development of the industrial cost recovery system and no more than 80 percent of the grant shall be paid unless EPA has approved the ICR system.

Because of recent congressional activity in formulating amendments to the Federal Water Pollution Control Act it is likely that many of the requirements noted above will change in the very near future.

EPA will also not pay more than 80% of the construction grant (step 3) until it has approved a sewer use ordinance and that such ordinance will be enacted and enforced before the completion of construction. This ordinance must prohibit new connections from inflow sources into the sanitary sewer and ensure that new sewers and connections are properly designed and constructed.[52] It must also control the discharges of harmful substances to the system. (While EPA has yet to issue final rules and regulations regarding pretreatment it is likely that payment of up to 10% of the construction grant (step 3) would be withheld until EPA has approved the grantee's pretreatment program.)

In the next few years, a new generation of NPDES permits will be issued, pretreatment standards will be established, public waste treatment may become more regionalized, and industry will make decisions whether to discharge directly under an NPDES permit or to pretreat, pay industrial cost recovery and user charges, and discharge into a public waste treatment system. With stricter standards, many businesses will either have to change their methods of operation, or install pollution control equipment, or do both in order to conform with the law. The 208 management program could improve voluntary compliance with the new requirements by disseminating basic financial and technical information to industrial firms.

The ability of the Federal-State-areawide effort to prevent and abate water pollution will depend in large part upon the extent to which private industry voluntarily complies with pollution control standards and the effectiveness of government action in obtaining such compliance. While the Federal Government and the Commonwealth administer regulatory programs to limit discharges into waterways and affecting groundwater, they also offer a variety of financial assistance programs to induce industrial and commercial businesses to acquire or construct pollution control systems. Federal and State tax benefits and financing programs reduce and soften the effect of investing in pollution control facilities. Tax benefits reduce and postpone tax liability through the investment credit, rapid amortization, and exemptions from the property tax.

Tax-exempt industrial revenue bond financing and small business loans and lease guarantees reduce the cost of financing. (For more information on these programs and their relationship to 208 management, see MAPC-208 paper entitled "Governmental Assistance for Financing Pollution Control Systems and 208 Management.")

Since the word "sewage", as it is used in Chapter 83 of the General Laws, includes "wastewater from homes, public buildings, commercial or industrial establishments...,[53] the authorization to a city or town to construct and operate sewerage systems clearly includes their ability to "accept for treatment industrial wastes." This required authority should be construed with reference to section 208(b)(2)(C)(iii), which requires the establishment of a regulatory program to "assure that any industrial or commercial wastes discharges into any treatment works in such area meet applicable pretreatment requirements." Therefore, in considering the ability of local governments to comply with the authority required for 208 management agencies the question must be whether local government can require industrial or commercial waste to meet applicable pretreatment requirements. As noted above, an effective pretreatment program has yet to be developed by either federal or state government. However, General Condition 20 of each municipal/NPDES permit requires the permittee to have in effect a sewer use ordinance which prohibits the introduction of any pollutant which "is a toxic pollutant in toxic amounts" or is an "incompatible pollutant" or "has not been subjected to any pretreatment that may be required under Federal or State Law."

Under Chapter 83, section 10 of the General Laws a city or town may prescribe "rules and regulations regarding the use of common sewers to prevent the entrance or discharge therein of any substance which may tend to interfere with the flow of sewage or the proper operation of the sewerage system..." Additional authority can be found in Chapter 40 section 21(6) which allows towns to "make such orders and bylaws, not repugnant to law...(f) or regulating, under a penalty not exceeding fifty dollars for each offense, the use of common sewers..."

Summary - The preceding discussion, relating the powers of communities in the basin with the 208 management agency requirements, has attempted to show that a system including local management agencies could provide viable management alternatives utilizing existing legal authority. A discussion of the intermunicipal aspects and possibilities for 208 management follows. This discussion includes a section on the MDC, which, while it is a state agency has many of the characteristics of an intermunicipal district.

C. 208 MANAGEMENT IMPLICATIONS FOR MULTI-LOCAL GOVERNMENT

While the preceding section described the ability of local government to exercise many of the required 208 management authorities, it should be clear from the identification of alternative solutions to existing and potential pollution problems that situations exist where implementation of a solution at a strictly local level will not effectively deal with the problem, either because the problem cannot be confined within a community's boundaries or the most cost-effective approach would be the sharing of resources and/or expenses by two or more communities.

In this basin the role of the Metropolitan District Commission in providing sewer service must be considered when discussing multi-local management agencies. The MDC is, of course, an agency of state government which provides water, sewerage and park services to member cities and towns in the Boston metropolitan area, as well as maintaining the third largest police force in New England. Even though it falls within the structure of Massachusetts state government, the MDC can be considered a multi-purpose metropolitan service delivery agency or multi-purpose special district because of its functions and administrative structure.[54]

This discussion of multi-local management implications describes the legal authority, institutional structure and 208 management role of the available forms of multi-local government. Generally, these multi-local arrangements are possible under existing statutes, and we will rely on existing legal authority whenever possible in order to develop a 208 plan capable of being implemented. However, management arrangements requiring additional enabling authority will be proposed or considered if they are deemed to be necessary for effective wastewater management.

Land Use - The control of land use in order to maintain and improve water quality offers, under existing statutes, little opportunity for inter-municipal control. Zoning and subdivision control stand as the cornerstone of local autonomy. While fairly recent legislative action has somewhat eroded this autonomy for some types of development (the Anti-Snob Zoning Law - Chapter 774 of the Acts of 1969), and in some areas of the Commonwealth (Martha's Vineyard Act - Chapter 637 of the Acts of 1974) the role of local government in land use control remains pre-eminent.

However, under the state zoning act the planning boards of abutting cities and towns must be notified by mail of hearings to consider the adoption or amendment of a zoning bylaw, or hearings to consider requests for zoning variances or special permits.[55] The notice of a hearing on a proposed zoning change must also be sent to the regional planning agency (EPA). While these notice requirements will not ensure that actions relating to zoning which are inconsistent with regional plans, goals or interests will not take place, it will at least assist in identifying those actions and afford an opportunity to present regional or other communities' views. Additionally, an RPA is empowered under the new act to propose zoning changes.[56] But, since zoning techniques have little value in protecting water quality in highly developed and sewered river basins, regional initiative in local zoning for that purpose are not likely.

The existing State Subdivision Control Law, which sets procedural requirements for local planning boards, currently offers even less opportunity for inter-municipal and regional consideration of development within the purview of the statute than does the zoning act. There is no provision for notice to either abutting towns or the regional planning agency for the adoption of subdivision rules and regulations, or the approval of definitive plans. The proposed amendments to the Subdivision Control Law previously mentioned (House No. 3067) would improve this situation somewhat by allowing RPA review of subdivisions with "regional impact". It has also been suggested that proposed local subdivision rules and regulations be submitted to RPA's for review and comment, and that abutting municipalities be offered an opportunity to become involved in the approval process for subdivisions adjacent to their boundaries of neighboring communities. Both suggestions could assist in improved water quality management, and should be considered. In the absence of state enabling authority requiring it, it is suggested in the interests of intermunicipal and regional cooperation that local planning boards voluntarily allow the planning boards of abutting communities and the RPA to review and comment upon proposed subdivision plans which could have "regional impacts" particularly impacts related to water quality.

Public Health - The significant role that boards of health could assume in a 208 wastewater management system has been previously identified in the discussion of implications for local government. The possibility of an inter-municipal approach to carry out public health responsibilities has also been noted, specifically with reference to the local responsibility to permit subsurface systems between 2,000 and 15,000 gal/day and the increased burdens of an inspection and maintenance program. Additionally, the important role of the board of health in subdivision plan approval offers an opportunity, through a regional board of health, to consider some of the regional water quality implications of subdivision development. Of course, the scope of the present Subdivision Control Law would limit this consideration somewhat (see previous discussion).

Section 27A of Chapter 111 of the General Laws allows two or more towns, by vote of each, to "form a district for the purpose of employing therein a health officer and necessary assistants and clerks..." A joint committee of the boards of health of each participating community determine the duties and compensation of the health officer and other staff, with each paying a proportional amount of the costs. A town may withdraw from such a district by vote of the town. This section does not apply in Barnstable County or to any city in the Commonwealth. Because the health agent must work with the varying local health codes of each member community, as well as enforcing state sanitary and environmental codes, and works closely with the local board of health, this institutional set-up appears more akin to the joint employment of a professional health agent than the creation of a truly regional institution. Of course, it facilitates coordination and consistency among neighboring boards of health and provides an administrative set-up which is easy to work with in terms of assessing costs to member communities, while minimizing impacts on local autonomy. However, there is no assurance that regional concerns, if they conflict with local interests, would be adequately considered.

A more comprehensive enabling statute for regional health districts appears in section 27B of Chapter 111. It allows two or more municipalities (town, city or city with a Plan E charter) to vote to form a regional health district, which must be administered by a full-time director of health, and which shall have all of the powers and duties of the boards of health of constituent municipalities, except for powers and duties which the district may delegate to the constituent communities.

The regional board of health under section 27B must have at least one representative from each community, with each community with a population of over 10,000 having one additional representative for every population unit of 10,000 beyond the first 10,000. However, no municipality may have more than five representatives. These representatives may be either elected or appointed. Where the district includes one or more entire counties the county commissioners shall appoint a county representative to the district. Each municipality in the district must pay its proportional share of the cost and expense of the district. This proportion may be determined by valuation, population, or "any other method decided by majority vote of the board." The regional board of health may promulgate reasonable rules and regulations. However, the regional health district is held to a higher procedural burden than a municipal board of health in adopting rules and regulations, for it must give public notice and hold a hearing pursuant to Chapter 30 section 37 of the General Laws. Local boards of health can, of course, adopt regulations merely by publication once in the newspaper of the town.

This authority to form regional health districts has not been utilized to any great extent in Massachusetts. The alternative of a regional health district should become even more desirable as the burdens of enforcing state regulations become greater. Moreover, the complexity of public health issues, such as solid waste and subsurface sewage disposal, both within and between communities illustrates the need for increased professional administration.

For example, under Title 5, all systems up to 15,000 gallons per day must be administered by local boards of health. This means that most restaurants, apartment buildings, schools, beauty salons, gas stations, etc. must be permitted only by local boards. Since many of these facilities present complex waste disposal problems not found in residential systems, local boards of health will need more expertise and time to deal with the technical and administrative aspects of regulating these facilities. Of course, the extent of this impact will vary depending upon the types of growth or development pressures facing individual communities.

Previously, the state assumed jurisdiction of all systems over 2,000 gallons per day covering most types of facilities mentioned above. The state's withdrawal from this area was due to budgetary constraints. Should the legislature appropriate more money to DEQE in the future (DEQE estimates an annual cost to perform this responsibility of $250,000 to $300,000 a year), then DEQE asserts that it will then amend Title 5 and resume administration of systems between 2,000 and 15,000 gallons per day. While the increased responsibility for local boards of health under Title 5 is an incentive to form a more cost effective and technically capable regional health district, the considerable uncertainty as to the state's future actions in these areas may make this alternative less politically attractive.

Of the two forms of regional health districts set out in the General Laws, each has some drawbacks which must be considered by participating communities. Under Chapter 111 section 27A local communities have much greater control over the district's budget and expenditures than under 27B. Moreover, a community may withdraw from the district at any time, provided however, it votes to withdraw prior to December first of any year, such withdrawal becoming effective January first of the following year. A community can withdraw from a 27B district only after five years and then only if it votes to withdraw prior to July first of any year, such withdrawal becoming effective January first of the following year.

While a 27B district can adopt a regional health code, a 27A district uses the health codes of its participating communities. However, the 27B district is held to a higher procedural burden in adopting rules and regulations.

These two regional health district options are not the only methods by which towns can cooperate on local health problems. Communities may contract with each other (and many do) to share the services of health agents, or may simply employ such agents on a part-time basis. Additionally, a regional health district, altering the provisions of 27A or B, and possibly encompassing a greater range of authority and responsibilities could be formed by special act of the legislature or could, possibly, be formed under home-rule authority. In other words, the form of such a district could, within limits, vary to meet the needs of the participating of one or more additional regional health districts or the enlargement of existing health districts is an economical method of handling the added workload associated with the change in state role and/or the initiation of septic system inspection/maintenance programs.

Regional Refuse Disposal - An intermunicipal or regional approach to solid waste disposal is not only a desirable alternative, but is also becoming increasingly necessary as communities exhaust existing landfill sites, and more stringent federal and state regulations result in either the closing of some town landfills or increased operating costs.

The authority of Chapter 40, section 44, subsection A-K, authorizes a city or town, by vote of the City Council or town meeting, to create an unpaid three member regional refuse disposal planning committee. Committee members are appointed by the town moderator or mayor. Two or more town planning committees can then form a regional refuse disposal board. This board is authorized to draw up an agreement setting the terms for the formation of the district, including the organization structure of the regional refuse disposal district committee, the governing body of the district. Capital construction costs and operation and maintenance costs are apportioned to the member communities in accordance with the terms of this agreement.

The enabling statute gives the district the authority to purchase or take land by eminent domain; to construct and equip the facilities and to enter into necessary contracts; to incur long-term debt (not to exceed 20 years) and short-term debt in anticipation of revenue; to issue bonds and notes; to receive grants and gifts; and, to enter into contracts for refuse disposal with non-member cities and towns and other bodies politic, the United States and other persons.

While the statute noted above could be utilized by communities in this basin in dealing with their solid waste disposal needs, there should also be consideration of regional resource recovery facilities, particularly those facilities currently being planned which could serve some Lower Charles Basin communities.

The Northeast Solid Waste Committee project and the 128 West project are regional resource recovery projects currently being planned with the assistance of the Mass. Bureau of Solid Waste. These proposals do not require the formation of a district, although a district with limited authority might be formed if it would provide more effective administration. Basically, they call for the establishment of a contractual relationship between the privately-owned and operated disposal facility and each participating community. Financing is carried out under the terms of Chapter 40D, section 21 of the General Laws with bonds being backed by the contracts, which bind the communities to deliver a certain tonnage of waste each year.

The membership in the 128 West facility project currently includes 10 Lower Charles Basin communities and is therefore likley to be the major component in the solid waste disposal solution for this basin.

Publicly-Owned Treatment Plants - Any discussion of intermunicipal arrangements for the provision of sewerage in the Lower Charles Basin must focus on the MDC since the MDC currently serves all of the sewered cities and towns considered in this report.

The Metropolitan Sewerage District,[57] established in the Commonwealth in 1889, was the first legally constituted metropolitan district in the United States and originally served 18 cities and towns. In 1901, the Metropolitan Sewerage Commission and the Metropolitan Water Board (established in 1895) were abolished and the powers and duties were transferred to the Metropolitan Water and Sewerage Board. In 1919 the Metropolitan District Commission was created to assume the powers, duties, and responsibilities of the Metropolitan Parks Commission and the Metropolitan Water and Sewerage Board. With the creation of the Executive Office of Environmental Affairs in 1974, the MDC became a department within this cabinet level executive office.

The Metropolitan District Commission currently has an aggregate community membership of 54, with the Metropolitan Sewerage District currently having 43 member communities. The MDC is headed by a Commissioner and four Associate Commissioners. The Secretary of the Executive Office of Environmental Affairs (EOEA) appoints the Commissioner, with the approval of the Governor. The Governor appoints the Associate Commissioners. The Commissioner is responsible for the overall administration of the MDC and retains a veto power over decisions made by the Commission as a whole. However, the Massachusetts Legislature makes the overall policy decisions and controls appropriations for maintenance and construction of the system.

Requests for appropriations for operating and maintenance expenses, debt service and other special projects are projected annually and submitted to the Secretary of the EOEA for inclusion in EOEA's budget request. After review and adjustment by EOEA, the Executive Office of Administration and Finance (A & F) and the Governor, the total budget for the executive, legislative and judicial branches of government is submitted by A&F to the General Court where, after hearings and debate by the Senate and House of Representatives, it is enacted. It should be noted that those costs directly attributable to the water, sewer and parks districts are eventually reimbursed to the State by the cities and towns served by these districts.

For projects involving capital outlays of over $10,000 for acquisition of land or construction, reconstruction or repair of facilities a capital budget is prepared with a precedure for review similar to the one noted above for operating and maintaining expenses. However, for each project a legislative petition is prepared identifying the project, its costs and the proposed method of financing. Again, the capital budget is enacted by the General Court and approved by the Governor and thereafter serves as the basic tool in scheduling capital expenditures.

To finance large construction projects general obligation bonds are sold by the State Treasurer, backed by the full faith and credit of the state. Because the debt resulting from the sale of bonds to finance MDC projects is not incurred for the benefit of the entire state, it is classified as contingent debt, and the interest and principal payments relating to such debt are annually assessed against the member communities.

In 1975 the legislature amended the statute governing the operation of the Metropolitan Sewerage District. This act, Chapter 814 of the Acts of 1975, were drafted to assure that MDC could comply with the requirements of the

Federal Water Pollution Control Act Amendments of 1972; specifically, those relating to user charges, industrial cost recovery, pretreatment requirements, and the authority required by section 208(c)(2)G, to assure that each participating community pays its proportionate share of treatment costs.

Under the provisions of Chapter 814, section 6, operation and maintenance costs for the MSD will be assessed according to the following:

> "The proportions in which the cities and towns included in the Metropolitan Sewerage District system shall annually pay to meet the total cost of operation and maintenance, including replacement, of the system shall be based on their respective populations contributing to the system and on the population equivalents of other wastes contributed to the system by the respective cities and towns, as determined by the commission. If less than the whole area of any city or town is included in the metropolitan sewerage district, the contributing population and population equivalents only of that part of the city or town served by the district, as determined by the commission, shall be used as a basis for determining the proportions to be paid under this section..."

In fiscal year 1978 operations and maintenance charges will be computed to meet the provisions of Chapter 814. MDC member communities in this basin should be aware that a study on user charges and industrial cost recovery systems has recently been completed for the MDC. This report provides detailed information on how these systems will be developed and implemented.[58]

For the assessment of principal and interest charges, Chapter 814, section 5 states that:

> "The proportion in which each of the cities and towns included in the Metropolitan Sewerage District shall annually pay to meet the total interest and principal requirements for each fiscal year on debt incurred for the metropolitan sewerage district, shall be based on the respective population of said cities and towns as ascertained by the last preceding state census, and on the population equivalents of the industrial waste...contributed to that system by the respective cities and towns, as determined by the commission."

In compliance with the law MDC assessed its MSD member communities according to the above-mentioned provisions for fiscal year 1977. It does this by tabulating state census populations and estimating population equivalents for industries located in each of the MSD member communities. Population equivalents are only determined for those industries whose water consumption exceeds 50,000 gallons per day.

In addition to the provisions mentioned above for the assessment of operation and maintenance costs and principal and interest charges the cost of construction of extensions of the MSD system to provide service for additional cities and towns or to provide additional service for one or more cities and towns must be paid by the benefited cities and towns "to the extent that such cost is not met by federal or state construction grants." "The annual amounts required to finance such construction... shall be apportioned among such benefited cities and towns in proportion to the respective additional capacities thereby made available to them by such construction."[59] This provision would only apply to new members of the MSD in the Lower Charles Basin (perhaps the Town of Weston).

In terms of the management authorities required by section 208(c)(2) it can be stated generally that the MDC has sufficient authority to enable it to be designed as a 208 management agency for those functions it currently performs, i.e., the provision of sewerage for its member communities. Specifically, it has sufficient authority to enable it to "manage effectively waste treatment works and related facilities" in conformance with the 208 plan,[60] and it has authority to "directly or by contract, to design and construct new works, and to operate and maintain new and existing works" as required by the 208 plan.[61] While it has clear authority to "accept and utilize grants..." from the state and federal government[62], after authorization from the Division of Water Pollution Control, its authority to accept grants, or other funds from any source" (emphasis added) as required by section 208(c)(2)(D) is less clear. The authority contained in chapter 44 section 53A of the General Laws, allowing cities, towns or "other districts" to accept grants from a variety of sources could be broadly construed to include the Metropolitan Sewerage District (since the definition of "district" in Chapter 44 section 1 is very broad). In the alternative, the somewhat unique financing structure of the MDC, requiring a legislative petition for each capital outlay project over $10,000 could be viewed as sufficiently flexible to allow MDC to accept funds from any source by including such authority in the petition. In any event, it is not envisioned that this provision would preclude the designation of the MDC as a management agency under section 208. MDC's authority "to raise revenues, including the assessment of waste treatment charges: [section 208(c)(2)(E)] contained in Chapter 92 section 1-8A of the General Laws as amended by Chapter 814 of the Acts of 1975. Its ability to incur short and long-term indebtedness [section 208(c)(2)(F)] arises from its position as a state agency and its financing procedures described above. As was noted previously, Chapter 814 of the Acts of 1975, amending Chapter 92 of the General Laws was enacted, in pact, to allow the MDC in implementing the relevant part of the 208 plan, "to assure...that each participating community pays its proportionate share of treatment costs" [section 208(c)(2)(G)].[63] The provisions of Chapter 814, generally the assessment of costs to communities on the basis of population and population equivalents (different types for operation and maintenance costs or principal and interest payments), assures that MDC can meet this requirement.

The requirement that a designated management agency have the authority "to refuse to receive any wastes from any municipality or subdivision thereof, which does not comply with any provisions of an approved plan under this section applicable to such area" [section 208(c)(2)(H)] may be the most constroversial of all the section 208(c)(2) requirements.

On its face it would seem to require that a waste treatment agency have the authority to disconnect a participating municipality's (or other political subdivision's) sewer line hookup and/or refuse future hookups where the municipality (or subdivision) was in non-compliance with any applicable aspect of a 208 plan, including land use control provisions.

EPA has not proferred an interpretation of this requirement in either the regulations or guidelines. It has stated that this authority should only be utilized in extreme cases, and where other methods, such as negotiations, fines, moratoria and court settlements have proved unsuccessful.

One problem with a literal interpretation of section 208(c)(2)(H) is that the cure is worse than the disease; and, therefore, it would not be administered in practice. A cutoff of a municipality's sewer connection would result, in most situations, in the discharge of untreated wastewater into streams, rivers or lakes. The untreated sewerage would create a water quality and public health hazard. Because of the severity of the sanction and its counterproductive water quality effects, such a sanction would rarely, if ever, be used. Because it would not be used practically, it would not be an effective means of deterring non-compliance. Needless to say, such a sanction would probably never be used against a municipality which has failed to comple with non-waste treatment related 208 plan provisions.

A study on 208 management commissioned by EPA[64] suggests that the following authorities might satisfy section 208 (c)(2)(H):

- authority to cutoff certain non-complying users;

- authority to deny additional hookups to the system during periods of non-compliance or projected non-compliance;
- the right to impose fines, penalties, surcharges, or similar sanctions on the non-complying communities. (Including where non-compliance is non-waste treatment related.)

Although each of these authorities, by itself, seems to fall short before the rigor of the statutory language, taken together, they might well comply with section 208(c)(2)(H).[65]

The authority to cut off individual users or groups of users might be a sufficient sanction where non-compliance with the 208 plan is attributable to the discharge of identifiable users. This authority could come into play where an individual user's discharge is causing the treatment plant to malfunction or violate effluent limitations or water quality standards. However, here again there is the problem of the cure being worse than the ill.

Where non-compliance exists or is projected, due to overloading of the capacity of the treatment works, authority to impose a moratorium on additional connections would probably be an adequate sanction. As the moratorium could be applied against all prospective users (or certain classes of users), within a municipality, it would be consistent with the clause that wastes may be refused "from any municipality or subdivision."

The authority of the MDC to adopt reasonable rules and regulations covering the discharge of sewage, drainage, substances or wastes into its system is well established.[66] Moreover, such authority includes the ability to levy an assessment of damages against any municipality which fails to comply with such rules and regulations,[67] and to impose a fine against anyone who violates such rules and regulations of not less than $1,000 nor more than $10,000 for each day such violation continues, or to seek a civil penalty not to exceed $10,000 per day for such violation.[68] In the case of malicious injury to the system treble damages may be assessed and upon conviction a fine not exceeding $1,000 and imprisonment not exceeding one year may not be imposed.[69] Whether, in addition to these remedies, in the case of a persistent violation of the rules and regulations by a municipal authority, the MDC could proceed to seal up the offending local sewer at the point where it joins the metropolitan system is a question which has yet to be tested.[70] Considering the other available remedies and the resultant social and environmental impacts, it is unlikely that such a course of action would be pursued.

Combining the authority of the MDC noted above with the ability of the Division of Water Pollution Control to prohibit additional connections to publicly-owned treatment works if the conditions of the facilities' discharge permit are being violated.[71] The provisions of section 208(c)(2)(H) may be considered to be satisified. However, these sanctions could not be imposed for violations of 208 plan provisions not related to sewer use. Clearly, additional enabling authority would be needed by MDC and/or other potential management agencies (such as DWPC) if a strict interpretation of section 208(c)(2)(H) is adopted.

Finally, a management agency designated under section 208 must have adequate authority "to accept for treatment industrial wastes" [section 208(c)(2)(I)] . This required authority should be related to the 208 requirement that a regulatory program be established to "assure that any industrial or commercial wastes discharged into any treatment works...meet applicable pretreatment requirements" [section 208(b)(2)(C)(iii)]. The MDC, again, as a result of the passage of Chapter 814 of the Acts of 1975, has the authority to require that any municipal, industrial or other user of the system meet any applicable federal or state law regarding toxic and pretreatment standards [72] (subject to the sanctions mentioned above).

Under MDC "Rules and Regulations Covering Discharge of Sewage, Drainage, Substances, or Wastes to Sewerage Works within the Metropolitan Sewerage District" every user discharging industrial wastes into the Metropolitan Sewerage System, or a tributary system, must obtain a joint permit from the MDC and from the municipality where the discharge originates. These permits may contain such conditions as MDC and the municipality require, including applicable federal or state standards (Article IV, regulation 2 of the regulations). It therefore appears that the MDC has adequate authority to meet this requirement of section 208(c)(2)(I).

There are basically three other types of intermunicipal arrangements which could be effectuated for the purpose of providing wastewater treatment services between communities. They are the intermunicipal agreement, the special district (formed by a special act of the legislature), and the pollution abatement district (formed pursuant to the provisions of the Mass. Clean Waters Act). These arrangements are discussed in detail in other basin reports, but they are not appropriate for the communities in this report since intermunicipal sewerage arrangements in this basin all involve the MDC.

Summary - The preceding discussion of intermunicipal sewer service arrangements is designed to inform the reader of what is possible under existing legal authority. However, 208 planning must consider, "(t)o the extent practicable", areawide wastewater management.[73] Therefore, an areawide organization with direct authority over the design, construction, operation, maintenance and management of all new and existing facilities in the MAPC region will be suggested as a management alternative. A brief discussion of this and other areawide management alternatives follows.

D. 208 MANAGEMENT IMPLICATIONS FOR THE AREAWIDE MANAGEMENT SYSTEM

The 208 planning program is required to develop an areawide management system to implement its recommendations. The system must have within it adequate authority "to carry out appropriate portions of an areawide waste treatment management plan". There are very few limitations on the structure of the management system. It could be a new single agency or loosely linked grouping of existing governments or something in between.

However, EPA guidelines encourage the use of existing authority and existing institutions whenever possible. This makes sense from a political point of view, since major legislative action to establish new authority for water quality management might be difficult or impossible to achieve. It also makes sense from the perspective of plan implementation which could be delayed indefinitely while new authority is sought. Additionally, in Massachusetts, the basic legal tools for water quality management already exist at the state and local levels. The task of designing an areawide management system, therefore, involves finding appropriate means to coordinate the actions of different agencies at different levels of government toward the achievement of the nation's water quality goals.

Areawide Management Decisions - Before final decisions can be made on an areawide management system, several additional functions must be introduced:

- the alternatives themselves must be clearly defined;
- basic criteria for institutional evaluation should be applied;
- the opinions of potential management entities and citizens should be sought; and,
- the alternatives should be reviewed against the jobs to be done as identified in each of the Preliminary Basin Reports.

This last portion - the jobs to be done - must be determined through intensive review of the solution options by basin residents and officials. So, only general relationships to Areawide Management Systems can be made at this point.

Land Use - Zoning and subdivisions regulations are essentially local responsibilities, but in the context of water quality, they have some aspects which might be considered areawide in nature, for example:

- a community choosing to apply zoning or other non-structural solutions to prevent water quality problems, necessarily influences the choice and cost of solutions in neighboring communities and the area as a whole;
- the thoroughness with which land use controls are applied and enforced will influence water quality beyond the single community;
- the complexity of relating future development to the capability of the land to support it may call for planning, technical and legal skills which are not available in single communities but might be economically retained at an areawide level to provide technical assistance;
- local regulatory efforts must be related to areawide planning as it is updated through 1995;
- for a variety of reasons, neighboring communities may not be able to achieve needed coordination in spite of the notification procedures in the new Zoning Act (Ch. 808) and they may need a broader forum to facilitate cooperative action;
- regional planning agencies, some of which may be responsible for continuing 208 areawide planning, have new authority under Ch. 808 to review proposed changes on their own. The proposed amendments to the Subdivision Control Law would give RPA's authority to review local developments which might be regional in their impact;
- land use decisions for water quality at a local level must be related to decisions in other functional areas, i.e., air pollution, solid waste, water supply, housing, etc. These elements are best coordinated at an areawide level.

The extent to which an areawide management system obtains and exercises local land use authority is largely up to local government. An advisory and technical assistance role along with continuous planning and provision of a multi-community forum appears most consistent with existing RPA responsibility and authority. An alternative management system could concentrate considerable authority over local land use in a new Areawide Organization, including authority to review and override local land use regulation or development decisions deemed not in the regional interest or not consistent with the achievement of water quality goals.

Public Health - Minimum standards for subsurface wastewater disposal are set by the state and these standards, of higher ones set by individual communities, are administered by local boards of health. The desire by some basin towns to avoid or limit future sewering and the complexity of relating septic systems permitting to environmental factors and operating inspection-maintenance programs will place heavy burdens on the boards. Regional boards (discussed above) may be one solution. Technical assistance could also be provided at the areawide level which would help communities use 208 data and the 208 environmental pattern maps and methodology for determining development capability on septic systems.

Boards of health dealing with landfill siting issues could receive technical assistance from the areawide level under any management alternative. The assistance could deal with specific local siting questions or with the broader issues of solid waste management on a regional basis.

Conservation Commissions - In exercising the broad authority of the state's Wetlands Protection Act, Conservation Commissions could receive technical assistance from the areawide level under any areawide management alternative. The assistance would help the Commissions relate their actions to the achievement and maintenance of water quality goals. Additionally, both local conservation plans and applications for federal and/or state funds for land acquisition would be reviewed at the areawide level for consistency with regional goals including regional water quality and open space/recreation goals.

Publicly-Owned Treatment Works - The role of the areawide element of the 208 management system is the design, construction, operation, maintenance, management and financing of publicly-owned treatment works will vary with the management alternative chosen.

1. Design and Construction

In a management system relying on existing authority and institutions the responsibility for Step 1 and Step 2 facilities planning and design and Step 3 construction under section 201 of PL 92-500 would remain with the municipalities, pollution abatement districts and multi-local agencies as designated management agencies. The areawide element would review steps 1, 2, and 3 for consistency with the initial or updated 208 plan. The review would consider the secondary impacts of facilities construction, but it would likely be advisory with the state giving final approval after considering the areawide review and the statewide priority list. A new Areawide Organization could also be formed by the legislature with sufficient authority to conduct the planning design and construction of treatment facilities itself, or it might be formed with policy-setting authority over the facilities related activities of the designated management agencies as subdistricts of the areawide organization.

2. Operation and Maintenance

The responsibility for operation and maintenance of publicly-owned treatment works would remain with the municipal and multi-community districts which design and construct the facilities under a management system using existing institutions. The areawide element of the management system might carry out technical assistance and operation training to improve facilities operation. A new areawide organization could operate and maintain its own facilities or oversee these functions if they are performed by desisnated management agencies as subdistricts.

3. Management and Finance

Under a management system using existing institutions, the municipal and multi-community designated management agencies would manage their treatment works, adopt and enforce sewer use ordinances, pay the 10 percent share of construction costs plus the cost of local sewers, apportion costs, establish and collect user charges and industrial costs. The areawide element would assist in the formulation of sewer use ordinances, user charges and Industrial Cost Recovery formula. If a new areawide organization was established it could carry out all of the management and finance functions above or it could oversee and assist the performance of its subdistricts.

E. 208 MANAGEMENT IMPLICATIONS FOR STATE GOVERNMENT

This chapter has sought to identify the management implications of the proposed alternative solutions in this report. It has focused primarily on those implications for local governments, in order to apprise those public officials and citizens of what 208 planning will mean to them and their communities. However, 208 planning could also have a significant effect on the way state government functions in its various water quality related programs. It should be noted that, by federal regulation, the state is utilmately responsible for assuring that the requirements of Section 208 are met.[74] Some of these implications have already been noted in Chapter 4 of this report, either because the proposed solution requires some state action (as in the regulation of sanitary landfills) or because a management implication for a local or multi-local level of government involves a program with an existing local/state relationship (wetlands protection, Title 5, and the Mass. Clean Waters Act as a few examples). This section will not, at this time, attempt to detail possible management roles for state government. The Office of State Planning, under contract with the Massachusetts regional planning agencies conducting 208 planning, has drafted a 208 Management Alternatives report which deals with the 208 management implications for various state programs and regulatory functions. The recommendations of this OSP report are being reviewed, and, where appropriate, will be incorporated into 208 basin reports and the MAPC 208 management report. For this basin report those state programs deemed potentially important for 208 management will be briefly mentioned. They include in no particular order of importance:

Scenic Rivers Designation - Under Section 17B of Chapter 21 of the General Laws, the commissioner of environmental management with the approval of the Board of Environmental Management may designate rivers in the Commonwealth as "scenic" rivers and may apply restrictive orders which regulate, restrict or prohibit the "dredging, filling, removing, or otherwise altering of polluting" these scenic rivers. The regulations apply to the river and contiguous land (up to 100 yards from the natural bank). Appeal procedures and public hearing requirements are stipulated in the statute.

Until recently, little had been done to implement this statute. However, in January 1977, the commissioner of environmental management designated the North River as a demonstration project under the Scenic and Recreational Rivers Program. This project will consist of a detailed investigation of the characteristics of the river and its watershed to determine the type of orders of conditions which are appropriate. This study, now underway, will serve as a model for designation of other rivers in the state as scenic. Concurrent with the study of the North River, the characteristics of other rivers in the state will be reviewed as a preliminary step to possible eventual inclusion in the program.

The purpose of the protective orders to be issued by the Department of Environmental Management (DEM) are to promote the health, safety, and welfare, to protect private as well as public property, wildlife, freshwater fisheries, and irreplaceable wild, scenic, and recreational river resources. The maintenance of high water quality in the North River is clearly, integrally related to each of these purposes. Therefore, the protective orders applied by DEM, should be geared, at least in part, to the protection of water quality. Any land use which would result in the contamination of the river or which would adversely alter natural drainage patterns should be prohibited:

- Uses which would generate increased runoff should be regulated, including roads, parking lots and other impervious surfaces.

- Storage of hazardous materials such as road salt, petroleum products or any other potential contaminants should also be prohibited.

- Construction activities which through the alteration of natural vegetation or the exposure of soil would precipitate erosion problems on the river's banks should be prohibited.

- Use of on-site waste disposal methods requiring leaching areas should be strictly controlled within the Scenic Rivers corridor.

In addition to the North River demonstration project, DEM is presently conducting an inventory of other rivers which might be considered for future Scenic River designation. It is hoped that Scenic River designations can be coordinated with water quality planning and control activities. The MAPC is working closely with DEM and local citizens and officials to develop protective orders on the North River (on the South Shore) which will minimize adverse affects from point and particularly non-point sources of pollution, and will use this information to assist communities, individuals and organizations interested in Scenic River designation. Scenic River designation does not preclude local or state controls on the river corridor, and only preempts such regulation when Scenic River protective orders are stricter. It is also hoped that the anti-degradation policy, currently being reconsidered, will be drafted to compliment scenic river designation and will be consistent with 208 recommendations.

Designation of Critical Areas by EOEA - Chapter 21A, section 2(7) of the General Laws gives to the Executive Office of Environmental Affairs the responsibility "to develop statewide policies regarding the acquisition, protection and use of areas of critical environmental concern to the commonwealth". The legislature, in giving this duty to EOEA, was concerned with a number of specific types of critical areas including: rivers, streams and floodplains; great ponds, reservoir sites and aquifers of regional significance; inland and coastal wetlands; lands of prime productivity as determined by soil surveys; and the coastal zone. (Section 40(e) of Chapter 806, Acts of 1974). The MAPC Water Quality Project is identifying many of these same areas as water-related lands in need of additional attention to minimize adverse affects from development on water quality.

There have, to date, been only five requests for critical area designation in Massachusetts, and only one area, Cedar Swamp in Westborough, has been designated. Currently, the only legal effect of critical area designation is to require compliance with the Massachusetts Environmental Protection Act for projects otherwise categorically exempt, but the designation of Cedar Swamp has resulted in greatly lessened development pressure, and has induced the town to develop compatible controls.

The Coastal Zone Management Act requires states to develop a process for designating areas as Areas for Preservation or Restoration in order to protect them for their conservation, recreational, ecological, or aesthetic values. In Massachusetts, such areas will be designated by the Secretary of Environmental Affairs as Areas of Critical Environmental Concern, pursuant to Chapter 21A, section 2(7).

By regulations currently being developed, nominations of areas may be made by ten citizens, by towns or Conservation Commission, by state agencies, RPA's or members of the Legislature.

To ensure that areas nominated are critical, the regulations will require that no area shall be eligible for designation unless it contains at least five characteristics from a list provided in the regulations. These characteristics include barrier beach systems, shellfish beds, erosion areas, historic sites, scenic areas, recreation sites. In order to designate an area, the Secretary may consider the significance of the area in regard to the following criteria: public health, quality of the area, productivity, uniqueness, irreversibility of impact, imminence of threat, economic benefit. If the Secretary decides to proceed with a designation public notice is given for a hearing within twenty-five miles of the nominated area.

As a result of this designation, EOEA agencies will attach a high degree of scrutiny to their activities in the area, will not proceed with actions which could impair the values of the area, and will administer programs consistently with the EOEA policies regarding the acquisition, protection, and the use of such areas. State agencies outside of EOEA will be unaffected by the designation except pursuant to MEPA, where no project conducted or permitted by any state agency shall qualify for a categorical exemption if it is located in an Area for Preservation or Restoration.

A summary of Coastal Zone Policies that will apply to designated APR's is as follows:

- high priority application of the Coastal Wetlands Restrictions Program to salt marshes, sandy beaches, shellfish beds, and dunes, and possible restriction of some upland where necessary to ensure full protection of the APR.

- high priority application of the Inland Wetlands Restriction Program to protect anadromous fish runs that may exist.
- high priority implementation of the Scenic Rivers Program.
- high priority for open space funds if requested.
- high priority for water quality clean-up projects.

In addition the Coastal Zone Management Program recommends that the following activities be prohibited within designated Areas for Preservation or Restoration:

- the siting of energy facilities,
- new industrial discharges and the discharge of hazardous substances, including thermal effluent,
- new dredging except for maintenance of existing channels or for enhancement of shellfish and other marine food productivity,
- disposal of dredge spoil, except in instances when the spoil may be used for beach nourishment and/or dune stabilization, and
- the siting of new sewage treatment facilities.

It is essential that Coastal Zone Management programs and 208 plans be consistent at least in terms of policy and planning directions and criteria. Should conflicts arise the "conflict resolution process", involving the Secretary of Environmental Affairs, would be utilized.

Non-Point Source Regulation under the Massachusetts Clean Waters Act - Under the authority of Chapter 21, section 43(2) of the General Laws,the Division of Water Pollution Control could establish a permit program to control non-point sources of pollution. Of course, any non-point source permit program must consider the division's staffing and budget limitations. Additionally, most identified non-point sources of pollution are covered, to some extent, by other regulatory programs (landfills, septic tank, filling of wetlands, salt storage, etc.). Therefore, any implementation of this authority should be limited to non-point source problems not adequately controlled under existing laws and regulations. This authority could also be used as a back-up control mechanism where a community fails to take suggested actions (the enactment of a watershed protection district, for example) within a specified time period.

Regulations of Sewer Extensions and Connections - Chapter 21, section 43(2) of the General Laws (the Massachusetts Clean Waters Act) state that "no person shall...construct, effect, maintain, modify or use in any sewer extension or connection, without a currently valid -permit issued by the director of (DWPC) unless exempted by regulation of the director." Section 43(3) requires that "the director shall adopt regulations with respect to permit proceedings and determinations." To date, no regulations have been adopted to cover sewer extensions and connections. If this section were implemented the state's Division of Water Pollution Control could exercise much greater control over the introduction of industrial wastes into municipal systems and it would give greater state control over the development and enforcement of local sewer use ordinances.[75] It is also possible that this regulatory program could include water conservation measures, such as requiring, as a permit condition, the installation of water saving shower heads, toilets, etc., especially in communities where excessive flows into the system were a problem, or where sewering could result in the depletion of groundwater supplies.

Title 5 - State Environmental Code - Section 13 in Chapter 21A of the General Laws, added by Chapter 706 of the Acts of 1975, directs the commissioner of the Department of Environmental Quality Engineering to adopt, and from time to time amend, regulations which are to be known as the State Environmental Code. Title 5 of the State Environmental Code deals with the subsurface disposal of sewage. This area was previously regulated by Article XI of the old State Sanitary Code, authorized by section 127A of Chapter 111 of the General Laws. Title 5 regulations, developed after the substantial involvement of various interest groups, agencies and citizens went into effect on July 1, 1977. Therefore, discussion of Title 5 here will be based on the current regulations.

Section 13 of Chapter 21A of the General Laws broadens the purpose of the State Environmental Code to include not only "the health and well-being of the public" (as stated in General Laws, Chapter 111, section 127A), but also "matters affecting the environment." Public health must still be considered in the environmental code, but other environmental concerns must now be given equal consideration. Subsurface sewage disposal practices previously allowed under the State Sanitary Code must be reconsidered with regard to their impact on the environment. It is likely that practices which have minimal public health effects may result in the serious degradation of the environment. The pollution of groundwater is one such area that must be re-evaluated. The legislature has clearly indicated that subsurface disposal of sewage must not be done in a manner harmful to the environment, and every effort must be made to ensure that the tools provided by the legislature are used for the purposes for which they were intended.

Title 5 of the State Environmental Code requires a permit for the construction of individual sewage disposal systems (2.1). It also requires that installers of individual sewage disposal systems and persons engaged in the pumping and transport of the contents of such systems must also have permits (2.2 + 2.3). All of these permits are issued by the local board of health pursuant to the minimum standards set forth in Title 5, except that DEQE must approve the plans for any system on any lot where the total volume of the sewage must be disposed of is in excess of 15,000 gallons per day. Local boards may, of course, adopt stricter standards under the broad authority of section 31, Chapter 111 of the General Laws. A construction permit is good for two years from the date of issue unless construction has commenced (2.4). The permit application must be accompanied by a plan showing, as a minimum: the lot to be served, location and dimensions of the system, design and calculations, existing and proposed contours, location and log of deep observation holes, location and results or percolation tests, location of any streams, surface and subsurface drains and wetlands within 100 feet of the system, known sources of water supply within 200 feet of the system, location of any proposed well to serve the lot, location of water lines on the property, maximum groundwater elevation in the area of the sewage disposal system, and a profile of the system (2.5).

Individual sewage disposal systems cannot be approved where a common sanitary sewer is accessible, and where permission to enter such a sewer can be obtained (2.12). Individual systems must be designed to adequately treat the sewage flow estimates set forth in the regulations according to the type of establishment (2.13). The use of a subsurface sewage disposal system by more than one lot is prohibited (2.18). However, a variance may be provided from this prohibition, particularly where such systems are publicly owned. The owner of the system must maintain the system and have it cleaned or repaired when ordered by the local board of health. The board of health may cause the works to be cleaned or repaired and all expenses incurred to be paid by the owner. Systems must be "maintained in a manner that will not...cause the works to become a source of pollution to any of the waters of the Commonwealth" (2.19).

Each system, including the leaching area, must be provided with a reserve area of equal capacity to the existing system (2.22). Before issuing a Sewage Disposal Construction Permit, a representative of the approving authority must perform a site examination, witness the deep observation holes (at least 2 per lot required) and witness the percolation tests (at least one on the site of the leaching area required). The leaching area requirements, for both sidewall and bottom area, are set by the measured percolation rates. Soils with percolation rates of over 30 minutes per inch are unsuitable. There is no minimum percolation rate.

Disposal facilities, particularly leaching areas must be at least: 100 feet from a well or suction line; 100 feet from surface water supplies, including reservoirs and their tributaries; and 50 feet from all other watercourses (3.7).

The septic tanks must have an effective liquid capacity of 150% of the design flow estimated, but in no case less than 1,000 gallons, but where garbage grinders are used the capacity must be 200% of the design flow but not less than 1,500 gallons (6.1 + 6.2).

Grease traps must be installed in systems where large quantities of grease can be expected to be discharged. Grease traps must be inspected monthly and cleaned at least every three months.

The leaching area, whether it is a pit (which is preferred), gallery, chamber, trench or field, must be at least four feet above the maximum groundwater elevation.

The new code allows the use of humus toilets provided a full-sized properly functioning subsurface disposal system is available or can be constructed on the lot (17.2).

As was previously stated, anyone pumping or transporting the contents of privies, cesspools, or septic tanks must obtain a permit from the local board of health. The application for the permit must state the disposal site, and the location and method of disposal must be approved in writing by DEQE.

Variances to the provisions of the code (except where expressly prohibited) can be granted by the local board of health, where strict enforcement of the code would do "manifest injustice" and the applicant can prove that the same degree of environmental protection required can be achieved without structural application of the particular provision. DEQE can disapprove any locally granted variance (20).

The local board of health can order persons to comply with violated provisions of the code and must provide such persons with notice of the order and the opportunity for a hearing, upon request. Penalties for violation of the code can be as much as $500. Failure to comply with an order of the board of health can also result in a $500 fine with each day's failure to comply constituting a separate violation.

While the recently enacted Title 5 is an improvement over earlier subsurface disposal regulations, some additional changes could be made to make it more responsive to the implementation of final 208 plan recommendations. The prohibition against the communal use of subsurface sewage disposal systems should be relaxed to clearly allow the multiple use of subsurface sewage disposal systems in some circumstances such as: when existing systems pose a threat to public health, safety or water supply and the communal system is the most cost-effective sewage disposal alternative; when the communal systems are publicly owned;(a publicly-owned communal system is presumably allowed under existing statutes as a publicly-owned wastewater treatment facility) or, when the rights and responsibilities of the users of the system for its operation, maintenance and repair are clearly established including the right to inspect the system, the obligation to pay a proportional share of the cost of construction, operation, repair and maintenance of the system, and the obligation to use the system in a manner which would not damage the system. Other changes could include a mandatory inspection and maintenance (when necessary) provision, perhaps every three years as a minimum, and a provision that access manholes be clearly and permanently marked to facilitate maintenance. Groundwater determinations, through the digging of deep observation holes, should be prohibited, at a minimum during the months of June through October, when the groundwater elevation is likely to be exceptionally low. The distance requirement from a watercourse for a leaching facility should be expanded from 50 feet if information generated in the 208 planning effort indicates that a greater setback would aid in the prevention of water quality degradation. It is suggested that Title 5 be re-examined by DEQE when all the results of the initial 208 planning effort in Massachusetts are available.

Wetlands Protection - As previously mentioned in this chapter, the Wetlands Protection Act, chapter 131, section 40 of the General Laws, gives local conservation commissions regulatory authority over the removing, filling, dredging, or altering of "any banks, beach, dune, flat, marsh, meadow or swamp bordering on the ocean or on any existing creek, river, stream, pond or lake or any land under said waters or any land subject to tidal action, coastal storm flowage or flooding." In the event of unsatisfactory action or failure to act on the part of the conservation commission, an aggrieved party (including the applicant, abutters, or 10 residents of the municipality) or the commissioner of DEQE can request a new determination of significance and order of conditions from DEQE. The commissioner has authority to promulgate rules and regulations "to effectuate the purposes of this section."

The current regulatory definition of the word "alter" and the construction of the Wetlands Protection Act as containing much of the authority to "regulate the location, modification or construction of any facilities within such area" as required by section 208(b)(2)(C)(ii) of P.L. 92-500 has previously been mentioned. However, it should be noted here that DEQE is currently reviewing the Wetlands Protection

Act in depth in the hopes of clearing up difficulties in its administration and implementation. This opportunity to view the act in relation to 208 requirements should be taken advantage of. Additionally, the possibility of treating wetlands or regional significance differently than smaller or less important wetland areas should be considered, with referral to 208 plans and 208 planning and management agencies when appropriate.

Additionally, the state's Wetlands Restrictions Acts, Chapter 130, section 105 (Coastal) and Chapter 131, section 40A (Inland), administered by the Department of Environmental Management should be closely coordinated with the 208 and CZM programs, as DEQE's regulation of wetlands under the Wetlands Protection Act. This would ensure that wetlands deemed especially critical, where any development would harm the value of these areas, are protected to the full extent possible under existing statutes, and would give clear notice to developers and landowners of areas unsuitable for development. The implementation of the Wetlands Restriction Program should be substantially expedited through provision of CZM funding to increase staff capabilities, at least for the coastal restriction program. Proposed CZM funding to DEQE should also upgrade the Wetlands Protection Act process.

Regulation of the Storage and Uses of Road Salts - Under section 7A of Chapter 85 of the General Laws the storage of sodium chloride, calcium chloride, chemically treated abrasives or other chemicals used for snow and ice removal from roads shall not be done in a manner or place which may contaminate a water or groundwater supply. DEQE has the authority to issue regulations as to how such chemicals may be stored and may "by specific order, in a particular case regulate the place where such chemicals may be used for such purpose". The section requires any person using more than one ton of snow removal chemicals in a year to report annually to DEQE as to the amount used, specified by road section, and the amount of chemicals on hand. DEQE "may require studies...of the probable impact of proposed new or improved highways and the maintenance thereof by use of such chemicals upon reservoirs, ponds, streams, lakes, wetlands and the groundwater aquifers associated with both public and private water supplies."

The section gives DEQE broad authority to control how road salt is stored and used in the Commonwealth. However, the full implementation of this section has not yet been achieved in that no regulations under this section have yet been issued. While the state Department of Public Works is currently exercising care in its storage of salt, storing the chemicals in sheds whenever possible and experimenting with new policies to reduce the amount of salt used on roads, the activities of local highway departments continue to be largely unregulated in this area. The full implementation of this section would certainly assist in the abatement of non-point sources of pollution due to runoff from highways.

However, the failure of the legislature to adequately fund this section of the General Laws has seriously hampered DEQE's ability to promulgate regulations and require the annual reports on salt use.

Section 7A of Chapter 85 of the General Laws should be fully implemented. A number of specific deficiencies with current lack of enforcement should be corrected:

- Although the statute requires that all users of snow removal chemicals report annually to DEQE, compliance is far from complete. Many communities fail to respond and those that do often provide incomplete information regarding use, storage and drainage.

- There is presently no money nor staff at the state level to implement the section. Reports once filed, are not verified for accuracy, and potential problems are not investigated or pursued in any way.

- The format of the report is not ideal. Modifications could improve the quality and completeness of the data received.

Specific requirements concerning the storage and use of salt should be promulgated by DEQE:

- Salt should be stored in sheds on impermeable surfaces, e.g., bituminous concrete pads.

- Adequate drainage in the vicinity of the shed should be assured.

- Salt should not be stored in the immediate vicinity of municipal wells, surface waterbodies, or uncovered, or in aquifer recharge areas. Adequate setbacks from waterbodies and covers should be assured.

- All towns should develop maps of local drainage basins and road networks which drain to salt-sensitive areas; e.g., aquifers, wells, streams tributary to reservoirs and should develop a program of salt use that designates certain sections of roadways to receive: a) sand only, or b) sand/salt mixture. The state DPW should be required to comply with local programs.

A recent act of the legislature (Chapter 356 of the Acts of 1977) provides funds for the construction of salt storage facilities. A sum "not to exceed one million dollars" is available to cities and towns for the construction of salt storage sheds. These funds are administered by the Commonwealth's Department of Public Works. Communities with existing water quality problems due to salt contamination will be given priority in receiving these funds. Communities supplied by MDC water will generally be ineligible.

Regulation of Drinking Water - The State Department of Environmental Quality Engineering has recently enacted drinking water regulations for all public water systems in Massachusetts pursuant to the authority conferred by Chapter 21A, section 2(28); chapter 92, section 17 and chapter 111, section 160 of the General Laws. These regulations are drafted to allow DEQE to obtain primary enforcement responsibility under the Federal Safe Drinking Water Act (42. U.S.C. §§ 300f-300g-5). The state will assume this responsibility as of December 1, 1977. They include siting requirements for new or modified public water systems; maximum contaminant levels for microbiological contaminants, organic and inorganic contaminants; turbidity contaminants and radionuclide contaminants; laboratory certification requirements, secondary standards for drinking water; distribution storage requirements, and regulations relating to surface water and groundwater supplies.

It is likely that some Lower Charles Basin communities will not meet the sodium concentration standards in these regulations for maximum contaminant levels for inorganic chemicals. While failure to meet the sodium standard will not subject the supplier of water to any enforcement action under these regulations, or require the obtaining of a variance or examption it will require the supplier of water to report the noncompliance to DEQE and to notify persons served by the system of the failure to meet the standards, together with an explanation of the reason for the presence of the substance and possible ways of correcting the situation. This notice must be sent at least annually by inclusion with a water bill.

This notification procedure also applies for failure to meet a secondary standard. Secondary standards include maximum contaminant levels for iron, manganese, sulfate and chloride. The maximum contaminant level for chloride is 250 milligrams per liter. It is also likely that some communities in this basin will fail to meet this secondary chloride standard.

F. 208 MANAGEMENT IMPLICATIONS FOR FEDERAL GOVERNMENT

Since this report deals primarily with the water pollution problems and possible solutions in the basin, this section describes federal management roles as they relate to the problems and opportunities identified in this basin. Some federal programs have already been identified and referred to in this report with respect to local and state activities

(The Clean Air Act, BOR's land and water conservation fund, and, of course, various aspects of the Federal Water Pollution Control Act Amendments of 1972). This section will describe those federal programs not previously mentioned which could assist in implementing the report recommendations.

Soil Conservation Service Activities - The Soil Conservation Service was established in the U.S. Department of Agriculture by Congress in 1935 to plan and carry out a national program to conserve and develop the nation's soil and water resources through conservation districts (P: 74-46). Soil Conservation Service personnel provide planning and direct technical assistance to soil and water conservation districts. In Massachusetts, conservation districts are formed under the provisions of Chapter 21, section 18-25, which also establishes a Division of Conservation Services within the Executive Office of Environmental Affairs. Much of the information available from the Soil Conservation Service (soil surveys, etc.) has been used extensively in the development of 208 plans. In addition, technical assistance is available to land users in determining alternative land uses and non-point source treatment needs and in developing a conservation plan reflecting these land use and treatment decisions. Technical assistance is also available to cooperating land users in installing planned conservation practices including necessary site investigations, design and specification, construction plans and layout practices. Supporting this assistance are technical guides and other technical materials which include (1) an array of resource information, (2) soil and site information with interpretations for various uses, (3) resource management to improve, maintain and reduce pollution, (4) practice standards and specifications, and (5) cost-return and other economic information. Therefore, soil conservation service personnel and conservation districts could provide technical assistance to landowner and land users, help prepare and revise conservation plans, make field investigations and recommendations on land use, and provide technical information to government bodies for use in enacting zoning ordinances, land use regulations, health codes and earth removal ordinances. The National Association of Conservation Districts, through its Sediment Control and Manpower Project (SCAMP), can assist conservation districts in manpower and training needs by providing manpower planning, training materials and general guidance to state agencies and conservation districts for sediment control activities.

Soil Conservation Service programs of interest to the Lower Charles Basin communities and which could be of assistance in implementing some of the recommendations of this report include:

- The Massachusetts Natural Resources Planning Program which assists communities in developing an inventory of present natural resources (done as part of the Natural Resource Inventory Program), evaluating those resources against established guidelines, determining the consequences of proposed actions on the natural resource base, and planning the acceptable course of action to maintain and improve the community's environmental quality.

- Soil surveys and special soil reports for communities which provide detailed soils information for communities and can indicate appropriate uses on such soils.
- Town Comprehensive Plans for the wise use and conservation of a community's natural resources.
- Massachusetts Water Resources Study prepared in conjunction with the Massachusetts Water Resources Commission which identifies potential and existing upstream reservoir sites, determines present land use and projects future land use, identifies and evaluates existing wetlands in selected areas and delineates selected floodplains with alternatives for reducing flood damages. Such a study was recently completed for the Charles River Basin.
- Flood Hazard analyses which define existing floodplains and provide data needed by units of government to develop a floodplain management program that will effectively reduce flood losses.
- P.L. 566 Watershed Program which can provide federal technical and financial assistance in identifying and solving land and water problems such as flood prevention, water supply, protection of fish and wildlife and prevention of erosion and sedimentation.
- Resource Conservation and Development Areas which are locally initiated, sponsored and directed programs, planned and carried out in areas where there is a need to accelerate the conservation and development of natural resources, improve the general level of economic activity and enhance the environment and standard of living.

For more information on these programs communities should contact their conservation district office.

Stormwater Management - On July 5, 1973, the EPA published regulations establishing policies and procedures for the issuance of National Pollutant Discharge Elimination System (NPDES) permits. These regulations excluded separate storm sewers, feedlot operations and agricultural and silvicultural activities from the requirement of applying for and obtaining a discharge permit. The regulations were challenged by the Natural Resources Defense Council as being an abuse of the administrator's discretion. The D.C. District Court ruled in favor of NRDC (NRDC v. Train,396 F. Supp. 1393, 7 ERC 1881 (DC DC 1975) and ordered EPA to promulgate NPDES regulations to cover these previously excluded point sources.

On February 4, 1977, EPA proposed a General Discharge Permit Program (42 FR 6846) to cover separate storm sewers and agricultural point sources. The proposed program is an attempt to comply with the court order without having to issue a separate permit for each storm sewer and agricultural point source discharge. It calls for the issuance of a general permit to cover separate storm sewers and/or agricultural point sources for each "general permit program area" (GPPA). The boundaries for the GPPA would be set by the regional EPA administrator, and, for storm sewers, could be designated 208 planning areas, sewer districts, city, county or state political boundaries, standard metropolitan statistical areas, urbanized areas, or any other appropriate divisions which will encompass in one or more areas all separate storm sewers subject to the same general permit conditions. The general permits would be for a fixed term not to exceed five years. The general permits could contain any condition the regional administrator "may reasonably determine necessary to progress in reducing pollution and meet the goals of the Act" (proposed regulation §. 125.55(j)(4). However, no general permit could be issued "for any discharge from a point source in conflict with a plan, or an amendment thereto, approved pursuant to section 208(b) of the Act" (proposed regulation §. 125.55(j)(2)(iii). For such discharges an individual NPDES permit can be required.

These proposed regulations, if promulgated, could provide a means of controlling pollution from separate storm sewers by the implementation of "best management practices" recommended by 208 plans. Where a particular discharge has been identified as causing significant pollution and "best management practices" are not adequate, or are not being implemented by the "owner or operator" of the storm sewer, then an individual NPDES permit could be required. This should provide some incentive for the local implementation of "best management practices" such as the ones proposed in this report.

Solid Waste Management - The Resource Conservation and Recovery Act of 1976 (PL 94-580) recognizes solid waste to be a uniquely local problem, which should be managed by states, local government, and regional groups. The new law amends the Solid Waste Disposal Act of 1965 to provide federal regulation of hazardous wastes, financial assistance to states for solid waste management planning, and funding for research, development, and demonstration of new technology for garbage reduction and disposal and resource recovery. The bill emphasizes development of methods for extracting usable metals, paper, glass, and energy from wastes.

The legislation also strengthens and broadens EPA authority to regulate solid waste and creates an Office of Solid Waste in EPA headed by a new depute administrator.

Hazardous waste regulation, presently under the control of the Division of Water Pollution Control, may remain under state regulation as long as federal requirements are met. Appropriations of $25 million per year are authorized in fiscal 1978 and 1979 to help states develop and implement their own regulatory programs.

State solid waste management planning grants are authorized for fiscal 1978 and 1979. Such plans must comply with EPA standards that include a phaseout of open dumps within five years. State plans must also identify responsibilities of states, regional and local authorities and strategies for funds distribution.

The law also provides grants for local authorities. Another $15 million in 1978 and 1979 are authorized for local authorities for such purposes as facilities planning, feasibility studies, market surveys, source separation projects, etc., but may not be used for construction or land acquisition.

This act should be important not only in planning for effective solid waste disposal, but also in dealing with associated sludge management problems.

Section 201 Facilities Planning - Under Section 201 of the Federal Water Pollution Control Act Amendments of 1972, the EPA administrator is authorized to make grants to "any state, municipality, or intermunicipal or interstate agency for the construction of publicly-owned treatment works." This is, of course, the program which has enabled many communities to begin work on upgrading existing treatment facilities or constructing new facilities.

Through federal and state funding, which combined pay for 90 percent of the eligible construction costs, there is a tremendous incentive for communities to construct these facilities. While it is necessary for many communities in the Metropolitan area to construct these new facilities in order to meet the requirements of the act, calling for publicly owned treatment works to attain secondary treatment by July 1, 1977 [section 301(b)(1)(B)], many communities may be choosing expensive municipal sewerage systems without adequately evaluating some of the less expensive, non-structural alternatives. Additionally, communities are induced to deal with pollution problems after they become problems, rather than taking less expensive preventative measures which might forestall or, in some cases, eliminate the need for expensive sewering. This situation has resulted primarily because section 208 planning was not funded until several years after the passage of PL 92-500, while the section 201 construction grants program was funded immediately and even though the funding was impounded for a time the construction grants program has been a functioning program for the past several years. Added to this is the fact that current section 201 construction grant funds apportioned to the states, must be expended by September 1977 or returned to the federal government. This has further increased the pressure on local communities to apply for, and utilize these funds at precisely the same time that 208 plans, nearing completion, are making communities aware of alternatives to sewering. This has had a greater impact on the less developed suburban communities across the nation than on the highly developed and sewered communities of the Lower Charles Basin.

EPA is beginning to recognize that this incentive for large-scale sewering is often not in the best interests of the municipality, because of high operation, maintenance and other grant ineligible costs. Also, it is often not in the interest of water quality because extensive sewering often results in increased growth in an area which frequently causes significant non-point source problems. EPA has issued a program guidance memorandum more clearly defining the 201 grant eligibility of septic tanks and other small treatment systems. This is a step in the right direction even though it comes too late to influence the state's allocation of current 201 funds. However, the incentive for a community to attempt to resolve its water pollution problems through sewering still exists because the main source of federal funds for communities to deal with water pollution problems is 201 funding for publicly-owned treatment works. Non-structural solutions generally cannot fall within this "publicly-owned treatment works" definition. Proposed amendments to the Act would enable EPA to promote less costly alternatives to centralized sewage treatment.

Additionally, approaches for reducing pollution from separate stormwater discharges, while legally eligible for 201 construction grant funds, are not generally approvable for construction grants (according to EPA Program Guidance Memorandum #61). While non-structural control techniques may be more cost-effective for reducing pollution from stormwater, this lack of any form of incentive to deal with stormwater discharges makes this another example of federal inability to assist in the implementation of 208 plan recommendations.

Finally, as a related issue, it should be noted that the requirement of the Act [section 301(b)(i)(B)] calling for secondary treatment by publicly owned treatment works should be reevaluated for deep ocean outfalls in light of studies which indicate minimal environmental improvement for the significant additional costs involved. The expenditure of funds for the construction of treatment facilities should be evaluated in light of water quality benefits, and compared to the costs and benefits of dealing with stormwater and non-point sources of pollution. It is likely that the Act will be amended to allow for primary treatment with deep ocean outfalls in some cases.

Section 314 - Clean Lakes Program - Section 314 of the Federal Water Pollution Control Act, as amended, provides that each

State shall prepare or establish and submit to the Administrator of the Environmental Protection Agency: (1) an identification and classification according to eutrophic condition of all publicly owned freshwater lakes in such state; (2) procedures, processes, and methods (including land use requirements) to control sources of pollution of such lakes; and (3) methods and procedures, in conjunction with appropriate Federal agencies, to restore the quality of such lakes.

Grants of up to 70 percent of the funds expended by states to carry out these methods and procedures are to be made available under this section. In addition, the Administrator of the EPA is authorized, by section 104(h)(A), to enter into contracts with, or make grants to, public or private agencies and organizations and individuals for the purpose of developing and demonstrating new or improved methods for the prevention, removal, reduction, and elimination of pollution in lakes, including the undesirable effects of nutrients and vegetation.

It is under the authority of these two sections that EPA has developed its "Clean Lakes" program. While this program has not been funded to the extent first envisioned by Congress, some 34 million dollars in funds have been apportioned to date (15 million for this fiscal year - nationwide). These funds are available on a 50 percent matching basis.

The history of section 314 offers some interesting insights into the current structure of the program and the limited emphasis on its implementation. Section 314 was originally introduced as a separate bill in 1972, known as the Clean Lakes Bill, sponsored by then-Senator Mondale and Senator Burdick. The bill was first introduced in 1966. The section was not part of EPA's original proposal, but was added by the Water Pollution Subcommittee of the Public Works Committee. It's most enthusiastic support came from those Senators and Congressmen representing the states of Minnesota, California and Maine, as might be expected.

In a letter to the Chairman of the House Committee on Public Works, dated December 13, 1971, William D. Ruckelshaus, then Administrator of EPA, stated EPA's position on the bill. In reference to Section 314 he stated:

> "We strongly oppose these provisions. We can see no valid reason to separate from the national program bodies of water or categories of water, such as fresh water lakes. Those lakes, just as other bodies of water, can be more effectively addressed under our comprehensive programs of grants, ,research, demonstrations, technical assistance, planning and regulations. There is no separate technology unique to pollution control in fresh water lakes to justify the separate address to these problems Section 314 would authorize."[76]

The Office of Management and Budget concurred in EPA's recommendations.

Nevertheless, Section 314 was included in the bill reported out of both the House and Senate Committees. The problems of accelerated sedimentation, agricultural runoff, accumulated sludge and municipal-industrial pollution leading to excessive eutrophication was thought to be such a severe problem as to warrant special attention and additional funds.[77] In reality, its inclusion in the final bill was probably due more to the political power of Senators Humphrey, Mondale and Burdick, among others, than any evidence that special attention was required for cleaning up the lakes.

EPA's initial attitude that the problems of lakes should be first addressed by the other programs under the Act appears to be their position even today as stated in EPA's 314 grant application guidance booklet:

> "The thrust of the "Clean Lakes" program will be to support those lake-restorative methods and procedures that would otherwise not be supported or implemented through other avenues of the Federal Water Pollution Control Act, or other applicable Federal programs.[78]

An application for financial assistance can only be made after a specified and detailed course of action to restore the lake has been decided upon. Detailed information on the lake, its drainage basin, the problems involved, the actions proposed, rejected alternative measures, relationship to other programs, an analysis of current baseline data and proposed monitoring programs has to be included in the application. An environmental asssssment under NEPA on the impacts of the project is also required. The costs of developing such information are not grant eligible. The limited availability of funds, and the great number of lakes for which assistance may be required is said to be the reason whey federal grants are limited to 50 percent of the grant eligible costs and why only the restoration projects themselves are eligible for funding. Requests to step up the program, including a request from Vice-President Mondale to EPA Administrator Costle to review and evaluate the program have thus far not resulted in any greater emphasis on the program. Among the recommendations which were made concerning the section was a proposal to increase the level of funding, increase the federal share to the full 70 percent authorized in the statute, and the adoption of a 3-step grant program - similar to the existing 201 program - providing funds for the planning, design and implementation of lake restoration projects, including the funding of certain lake management techniques currently ineligible, such as the harvesting of aquatic vegetation. Favorable EPA action on these recommendations does not appear likely at the present time.

In the MAPC-208 area three section 314 projects are currently underway (Morses Pond in Wellesley, Lake Cochituate, and the Lower Charles Basin) with another project in the application stage (the Lower Mystic Lake). There are, however, a number of lakes and ponds in the MAPC 208 area that have significant water quality problems caused by various point and non-point sources of pollution which could benefit from detailed study and the implementation of restoration projects. Unfortunately for most of these waterbodies, the detailed planning and analysis necessary for a 314 grant application has not been done, and absent fairly reliable sources of federal funding at levels which provide a real incentive, communities are reluctant to undertake these studies. Only when there is a real danger of an important community resource being permanently lost or when state enforcement action on a related environmental problem, such as a polluting landfill, is present is there a sufficient incentive for community action.

The MAPC-208 project, while developing much important land use and water quality related information, cannot, because of the scope of its study, the size of its planning area and resultant level of detail which its information must be developed at, provide the detailed information necessary to identify specific courses of action necessary to insure the restoration of these waterbodies. It has been suggested by one prominent environmental advocate in the Charles River Basin that as the impact of non-point sources of pollution are more severe on impounded bodies of water, the section 314 program should be re-vamped to provide the necessary funding to identify these impacts more conclusively, and design and implement programs of both a structural and non-structural nature for their abatement. The use of the section 314 program to provide the necessary monetary incentives to fund the implementation of structural and non-structural pollution abatement activities is clearly an idea whose time has come. Additionally, the need to counter the over-emphasis on the use of traditional engineering approaches to achieve the goals of the Federal Water Pollution Control Act that the high-level of funding of section 201 has brought about is another reason for shifting some emphasis to the section 314 program.

The detailed planning and design that section 201 requires must be done in a program that considers all pollution sources if the goal of "water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water..." (section 101(a)(2) of P.L. 92-500) is to achieved by 1983.

The Safe Drinking Water Act of 1974 (P.L. 93-523) - The Safe Drinking Water Act (SDWA) provides for the safety of drinking water supplies by establishing and enforcing national drinking water standards. EPA is responsible for establishing federal standards and the state is responsible for enforcing standards and otherwise supervising public water supply systems.

Major provisions include:

- Establishment of primary regulations for the protection of public health.
- Establishment of secondary regulations regulating to taste, odor, and appearance.
- Measures to protect underground drinking water sources.
- Research and studies regarding health, economic and technological problems or water supplies.
- Aid to the states to improve drinking water programs.
- Monitoring of drinking water supplies.
- Notification to customers of failure to comply with the drinking water regulations.
- Variances and exemptions to extend the time of compliance by any public water system.

The provisions of primary interest to 208 planning include the measures to protect underground drinking water sources and the monitoring requirements for surface and underground drinking water supplies.

The act requires EPA to develop minimum requirements for state programs to prevent the endangerment of underground sources of drinking water from the uncontrolled underground injection of fluids. The burden of proof of non-endangerment is placed on the injector who must maintain monitoring records or report periodically to the state. Since the SDWA has no general planning provisions which are related to groundwater protection, the EPA intends to rely on such provisions in Section 208 of PL 92-500 which is to devise "a process to control the disposal of pollutants on land or in subsurface excavations within such areas to protect ground and surface water quality.

Future likely drinking water standards and monitoring requirements for public water supplies in this state are specified in the drinking water regulations of Massachusetts promulgated by DEQE. According to the SDWA, these regulations must be at least as stringent as Federal regulations. State drinking water standards and monitoring requirements have been developed for contaminants including microbiological, inorganic, organic, turdibity and radionuclide.

The bacterial standard requires a sampling frequency dependent upon the population served, with the minimum number of samples per month ranging from 1 to 500.

Standards for inorganic contaminants require sampling, once a year for surface supplies and at three year intervals for groundwater supplies. Inorganic contaminants include nitrate, sodium, arsenic, barium, cadmium, chromium, lead, mercury, silenium, silver, and flouride. The twenty chemical quality parameters analyzed under previous state standards will continue to be analyzed on an annual basis. Iron, manganese, sulfate and chloride will be similarly analyzed, but standards for these contaminants are secondary, based on taste, odor or appearance only.

Organic contaminant standards are proposed for six chlorinated hydrocarbon pesticides. Surface water supplies are required to be analyzed for these contaminants at no less than three year intervals. Only those groundwater systems specified by the Department are required to be analyzed for organics.

The radionuclide standard requires analysis of all community water supplies every four years. Daily analysis of surface water supplies are required to determine the contaminant level for turbidity.

While proposed regulations require analysis of a larger number of parameters than previous regulations, the sampling frequency is generally lower. Water supplies which were identified in earlier sections to be potentially affected by landfills should be chemically analyzed at more frequent intervals than required under the proposed regulations. More frequent sampling can protect public health by early detection of leachate contamination of drinking water.

This type of monitoring is not a substitute for monitoring of the landfills which were identified as possible problems. Landfill monitoring can provide information on the presence and movement of contaminated ground or surface water before the water supply is affected, permitting remedial measures to prevent contamination of drinking water. Monitoring of the water supply alone provides no advance warning of contamination and, therefore, does not serve to protect the supply. Public wells which intercept a plume of leachate contaminated groundwater may be lost to the community indefinitely. Water supplies which may be affected by salt storage and application deserve monitoring attention similar to that of supplies potentially endangered by landfills.

Natural Valley Storage[79] - In May of 1972, the U.S. Army Corps of Engineers New England Division announced its flood control program for the upper two-thirds of the Charles River Watershed. This program consists of acquiring 17 of the most critical wetland areas in the watershed in order to preserve them in their natural state so that they can effectively store storm waters and thereby provide an effective non-structural flood management mechanism. The acquisition of these areas was authorized by the Water Resources Development Act of 1974 (P.L. 93-251) which also requires that all future flood control projects consider non-structural alternatives and offers equal federal cost-sharing for these non-structural alternatives. It is expected to take about three years to acquire the approximately 8500 acres of NVS wetlands (3 of the wetland areas are on the main stem of the Charles, while the other 14 are in the tributary watersheds). The areas will be acquired according to priorities which have been set considering the area location, volume of storage capacity and degree of development threat. The Corps will offer fair market value for these areas to be acquired, but in the event of price disagreement or title deficiencies the Corps will file eminent domain proceedings.

No homes are involved in this acquisition program, no one will be denied access to the improved portion of his property, and no non-conforming lots will result from the acquisition program. Owners preferring to retain title to their land can execute a restrictive easement with the Corps to insure that the land is maintained in its natural state, without any alteration of its drainage characteristics.

As part of the NVS program the State has agreed:

(a) to prevent modification or alteration of existing roadways, utilities, bridges, culverts or any other improvements that might effect the drainage characteristics of the natural storage areas;
(b) to adopt and enforce regulations to restrict development of floodplains lands; and
(c) to operate and maintain the existing dams along the Charles River.

Additionally, the state legislation has been filed to grant the Commonwealth's consent to the federal government to undertake the program. Other legislation will authorize payment by the state in lieu of taxes to the communities affected by the loss of development capability of these wetland areas, according to the provisions of Chapter 58 section 17B of the General Laws.

A management committee, including representatives from the 16 NVS municipalities, pertinent state and regional agencies, including the MAPC, and private interest groups such as the Charles River Watershed Association, Mass. Audubon Society and the Trustees of Reservations, has been formed to consider the use of some of the NVS land for passive recreation, low-key nature study and natural wildlife habitat consistent with the purpose of flood control. Deed restricted lands will of course continue to be managed by the owner, subject to the provisions of the restrictive covenant.

Many of the lands to be acquired under this program have also been defined in the MAPC 208 planning process as critical lands which play a key role in the hydrologic cycle so that development in these areas should be restricted or regulated so as to safeguard water quality. The Natural Valley Storage program precludes the need for stricter state or local regulation and therefore offers a very equitable means of implementing, in part, 208 plan recommendations.

The National Flood Insurance Program - Under the Flood Disaster Protection Act of 1973 (P.L. 93-234), communities with areas designated as subject to serious flood hazards must adopt adequate land use control measures. Participation in the program is necessary in order to be eligible for federally subsidized flood insurance. After a community has joined the program and HUD issues the final "rate" maps, the community may appeal the boundaries to HUD, but must ultimately join the "regular" program and adopt land use regulations to minimize flooding and protect the 100-year "floodway". Generally, HUD will approve regulation of land use which raises the level of the dwelling above the 100-year flood level or floodproofs the lower floors. Communities may but need not go further and adopt more extensive local floodplain zoning. In most cases communities should adopt procedures to regulate all new development or construction; to assure that new or replacement water supply and/or sewage systems are designed and located to avoid impairment or contamination during flooding; and to prohibit fill or encroachments in a floodway that would increase the water elevation of the 100-year flood more than one foot. Restrictions should also limit flood related erosion.

Although the flood insurance program is not directly concerned with water quality, its requirements will be compatible with 208 plans in many areas. Restrictions on development, for example, may serve both goals by providing a buffer area around streams. The regulations of impermeable surfaces could also serve dual objectives.

(Note: On October 12, 1977, the President signed the 1977 Housing and Community Development Act. An amendment to the Act repealed the prohibition of federally insured private lending institutions from making loans to property owners in HUD-designated flood prone areas that did not participate in the HUD flood insurance program. Developers in flood prone areas will not, however, be eligible for federal disaster relief if the development does not have adequate flood proofing measures.)

CHAPTER 6: FOOTNOTES

[1] "EPA Draft Memorandum on Development of State and Local Section 208 Nonpoint Source Control Programs", reprinted in Current Developments, Bureau of National Affairs, Inc., Volume 7, No. 50 at. 1925.

[2] 40 CFR s. 131.11(n)(3)(i)

[3] EPA Program Guidance Memorandum, SAM-30, Aug.23, 1977 42 FR 44 776

[4] St. 1975, c.808 s. 2A

[5] See MacGibbon v. Board of Appeals of Duxbury 1976 Mass. Adv. Shs. 143; compare Turnpike Realty Co., Inc. v. Town of Dedham 362 Mass. 221 (1972)

[6] Simon v. Town of Needham, 311 Mass. 560 (1972)

[7] Wilson v. Town of Sherborn, 326 N.E. 2d. 922, 1975 Mass. App. Ct. Adv. Sh. 643

[8] Simon v. Town of Needham, supra. at 565-6

[9] Aronson v. Town of Sharon,346 Mass. 598 (1964)

[10] MGLA c 40A, s.9, amended by St. 1975, c.808

[11] IBID

[12] MGLA c.41, sec. 81M

[13] Daley Construction Co. Inc., v. Planning Board of Randolph , 340 Mass. 149, at 153, citing 1953 House Doc. 2249 at 54

[14] Fairbairn v. Planning Board of Barnstable, (1977) Mass. App. Ct. Adv. Sh. 284, 291

[15] United Reis Homes, Inc., v. Planning Board of Natick, 359 Mass. 621

[16] Hamilton v. Planning Board of Lexington, (1976) Mass. App. Ct. Adv. Sh. 506,507

[17] See Canter v. Planning Board of Westborough, (1976) Mass. App. Ct. Adv. Sh. 585, 588 and United Reis Homes, Inc., supra at 615.

[18] Fairbairn, supra at 286

[19] Fairbairn, supra at 303

[20] MGLA c. 21A s. 13; c. 111 s. 127A

[21] MGLA c. 111 s. 127

[22] MGLA c. 111 s. 150A

[23] MGLA c. 111 s. 122; see Stone v. Heath 179 Mass. 385, 60 NE 975

[24] MGLA c. 111 s. 122A

[25] MGLA c. 111 s. 143

[26] MGLA c. 111 s. 31

[27] Environmental Protection Agency, Construction Grants Program Requirements Memorandum "Eligibility of Septic Tanks, and Other Small Treatment Systems."

[28] Town of Holden v. Holden Suburban Supply Co. Inc., 343 Mass 187, 178NE 2d 74; United Reis Homes, Inc., v. Planning Board of Natick 270 NE 2d 402, 359 Mass. 621

[29] Bancroft v. City of Cambridge, 126 Mass. 438

[30] See United Reis Homes, Inc., v. Planning Board of Natick, 270 NE 2d 402, 359 Mass. 621

[31] Commonwealth v. Hadley, 351 Mass. 439, 222 NE 2d 681

[32] *Camara v. Municipal Courts of the City and County of San Francisco*, 387 U.S. 523

[33] *Lincoln v. Murphy*, 314 Mass 16,20; *Building Commissioner of Medford v. C & H Co.*, 319 Mass. 273,286

[34] *Waltham v. Mignosa* 327 Mass. 250, 253

[35] MGLA c. 40 s. 8c

[36] MGLA c. 131 s. 40

[37] "Regulations under the Wetlands Protection Act General Laws, Chapter 131, section 40", Feb. 25, 1977 section 2.3

[38] P.L. 92-500, section 208(b)(2)(C)(ii)

[39] "Statement of Coordination between Northeast Regional Office of the Bureau of Outdoor Rection (BOR/NERO) and Region I New England Region of the U.S. Environmental Protection Agency ((EPA (I))," topic of agreement #6.

[40] P.L. 92-500, section 208(c)(2)

[41] MGLA c. 41 § 63 and 65

[42] MGLA c. 41 § 21 and 69

[43] See MGLA c. 59 generally

[44] MGLA c. 83, § 14, 15, 15A, 16, 17, 20 and c.80 s.1

[45] 40 CFR 35. 935-13; 35. 935-16.

[46] 40 CFR 35. 925-11

[47] "Wastewater System User Charges", Camp, Dresser and McKee, Inc., January, 1977, prepared for the Town of Holbrook, Mass. pp. 10-11

[48] Ibid, p. 13

[49] 40 CFR 35. 905-8.

[50] 40 CFR 35. 925-12.

[51] 40 CFR 35. 928.2

[52] 40 CFR 35. 927-4, 35. 935-16.

[53] MGLA c.83 s. 1

[54] *See* EMMA Study, Vol. 12, Part 1 p.II-6; "Massachusetts Substate Government: A Report to the Secretary of Environmental Affairs", Birkhead, Campbell, and Weissman; Metropolitan Studies Program, Maxwell School, Syracuse University, August 15, 1972, p. 46.

[55] MGLA c.40A § 5 and 11, amended by st. 1975, c.808

[56] MGLA c. 40A s. 5, amended by st. 1975, c.808

[57] much of the following information is taken from the EMMA Study, Vol. 12, part 1.

[58] *see* "Final Report on a Conceptual Design for User Charge and Industrial Cost Recovery Systems", May, 1977, prepared for the MDC by Arthur Young and Company.

[59] MGLA c. 92 s.5B, as amended.

[60] *see generally*, MGLA c. 92 § 1-8A.

[61] MGLA c. 92 s. 1; c. 21 § 30A, 31.

[62] MGLA c. 21 § 30A, 31, 33.

[63] *see* MGLA c. 92 § 5-7.

[64] School of Public and Environmental Affairs, Indiana University, "Problems and Approaches to Water Quality Management" (October 1973)

[65] The following discussion is based in part on the analysis in "Problems and Approaches", at 57-60. The study, however, does not contend that each or any of the "realistic" sanctions evaluated would satisfy section 208(c)(2)(H) separately or where combined.

[66] see MGLA, c. 92 § 2 and 8A; Chapter 705, section 12 of the Acts of 1945;

see also V. Op. Atty. Gen. 559;
1941 Op. Att. Gen. 37.

[67] Chapter 705, section 12 of the Acts of 1945.

[68] MGLA c. 92 s. 8A

[69] MGLA c. 92 s. 3.

[70] see V. Op. Atty. Gen. 559, 562 (1920).

[71] MGLA c. 21 s. 44(2).

[72] MGLA c. 92 s. 6A

[73] 40 CFR 131.11(n)(3)(i)

[74] 40 CFR s. 130.33(a).

[75] see generally "Summary of Works Done in 1976 by Edward Selig, Esq., under contract (Project 76-13) with Division of Water Pollution Control."

[76] Legislative History of the Water Pollution Control Act Amendments of 1972 prepared by the Environmental Policy Division of the Congressional Research Service of the Library of Congress, Vol. 1, January 1973, p. 852.

[77] IBID Vol. 2, page 1486

[78] "Restoration of Publicly-Owned Freshwater Lakes Authorized by Section 314 of the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500)" Guidance for the Preparation of Lake Restoration Grant Applications, U.S. EPA, November, 1976, page 11.

[79] This information was taken largely from "Natural Valley Storage: a partnership with Nature" Public Information Fact Sheet Spring, 1977 prepared by the Charles River Watershed Association under contract with the U.S. Army Corps of Eingineers New England Division.

Appendix C

Definitions of Solutions to Water Quality Problems

APPENDIX C DEFINITIONS OF SOLUTIONS TO WATER QUALITY PROBLEMS

In this appendix you will find:

> Descriptions of the alternative solutions presented earlier and explanations of how these solutions work. This material is not community-specific. If you wish to read first about solutions appropriate for your town, you should find those solutions on the charts in Chapter 4 and refer to the table of contents for the page number of the solution description in this appendix.

For ease in reading and comprehension, these numerous alternatives are presented in four separate sections within this chapter.

A. Best Management Practices and the Environmental Pattern

B. Technological Water Pollution Control Alternatives

C. Landfills: Water Quality Impacts and Solutions

D. Stormwater Runoff

A. BEST MANAGEMENT PRACTICES AND THE ENVIRONMENTAL PATTERN

Many potential water quality problems are amenable to prevention by the careful application of land use, growth management and other controls. Regulation of the use, size, density and location of development — while employed for broader public purposes — can reduce and even prevent diffuse, non-point sources of pollution.

Land development tends to interrupt the functioning of the hydrologic cycle. Impervious surfaces increase stormwater runoff reducing the amount of water returning to the ground through aquifer recharge areas. Improperly sited or constructed septic systems increase the likelihood that nearby streams or ponds may become contaminated.

It is extremely difficult, and therefore expensive, to scientifically prove that a particular development project causes specific water quality problems. Moreover, cummulative evidence generally demonstrates that the more urbanized an area, the poorer its water quality. This is not to say that there should be no development, only that development should be properly planned and managed to minimize water degradation. EPA's term of "Best Management Practices" is appropriate in applying land development controls to prevent pollution. Essentially it means a pragmatic approach which relies upon available regulations and practices to reduce future levels of water pollution.

The MAPC Water Quality Project has developed a land use planning tool known as the Environmental Pattern. In simplest terms, the Environmental Pattern is a general set of land development capabilities based solely on considerations of water quality. It is formulated upon the principle that by developing within the natural capabilities of the land, potential sources of water pollution can be reduced or even prevented.

Wetlands, floodplains, aquifer recharge areas, topographic slope and soil limitations for septic systems form the natural data base. Maps of these water-related lands, singularly or in combination, define environmentally sensitive areas: "critical" areas for little or no development, and "fragile" areas for various degrees and kinds of development.

Environmental Pattern maps, along with local zoning maps, were used in the analysis of potential non-point source problems as described by community in Chapter 3. Some possible solutions discussed on a community basis in Chapter 4 also rely, to some degree, upon such mapping analysis. It should be understood, however, that the regional planning scale of the maps (1 inch equals 3,000 feet) is not sufficiently detailed or accurate for local or site planning purposes and it is not intended for such purposes. However, the zoning concepts which follow are valid when accompanied by local zoning maps as appropriate.

Land development controls and their use in minimizing water quality problems are briefly explained.

In addition, other management techniques such as criteria for salt storage and operating requirements for sanitary landfills also constitute "Best Management Practices" and are, therefore, included in this appendix.

A. ENVIRONMENTAL PATTERN METHODOLOGY*

The investigation of non-point sources is a key component of MAPC water quality planning. By definition, non-point sources are diffuse, not easily managed sources of pollutants. Typically, they are the result of improper land use decisions. Erosion of stream banks is often the result of poor construction practices. Poorly sited and operated landfills can contribute harmful pollutants to ground and surface water bodies. Septic systems constructed in poorly drained soils often fail, thereby releasing untreated effluent.

While existing non-point sources of pollution are difficult to abate, future problems of a similar nature can be avoided through careful land management. If land is developed in a manner that is consistent with its natural capability, many non-point sources will be prevented.

A planning tool known as the Environmental Pattern was developed in order to determine locations in the study area where certain kinds and intensities of development could be accommodated with minimum water quality degradation. The Environmental Pattern summarizes development capabilities based on the relationship of appropriate land uses, and development densities to natural land characteristics and provision of municipal utilities. This pattern has been mapped for all "non-urban" land in the planning area. Maps and accompanying matrices indicate which land uses and densities are appropriate throughout the region on lands with various characteristics. Land use types and densities vary depending on provision of public sewers, water and storm drains.

The Environmental Pattern is not a land use plan. It is a planning tool, used by 208 staff two ways:

- It served as the basis for identifying potential non-point sources of pollution throughout the region. By comparing current zoning maps to the

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* A more detailed description of the Environmental Pattern Methodology is found in the Appendix C-1 to this report, published under separate cover and available upon request.

Environmental Pattern those areas where permitted land use types and densities are inconsistent with the land's natural development capability are identified.

- The Environmental Pattern was also used in the process of "impact assessment". Possible impacts of the alternative solutions suggested in this basin report were evaluated.

B. NON-STRUCTURAL SOLUTIONS: LAND DEVELOPMENT CONTROLS

Many of the water quality problems in the metropolitan Boston region can be addressed without the construction of extensive sewer lines and treatment facilities. Other problems will require a mixture of structural and non-structural solutions for their ultimate resolution. In either case it is important that the municipalities are fully aware of and understand the various options that are available to them.

A number of "non-structural solutions" which can be defined as land development regulations or water quality management techniques are discussed under four general headings: zoning, subdivision regulations, "innovative" controls, and other management practices.

It should be stressed at the outset that various options should be adopted to complement one another, not in piecemeal fashion. In the long run, only a comprehensive package of solutions combining appropriate non-structural as well as structural measures will adequately address both existing and potential water quality problems.

Zoning bylaws and ordinances - Zoning is probably the most well-known and widely used land development control at the local level. Massachusetts cities and towns are authorized to enact zoning bylaws and ordinances, including zoning maps, under provisions contained in the General Laws, Chapter 40A, known as the Zoning Act. Any zoning bylaw or ordinance requires a two-thirds majority vote of either the town meeting or city council and approval by the attorney general before becoming law. Municipal planning boards have substantive review powers and responsibilities in the process of enacting local zoning changes. Boards of zoning appeal are charged with case-by-case authority with respect to all zoning variances and some special permits, depending upon the local bylaw or ordinance. City councils, boards of selectmen, and more recently, planning boards and zoning administrators are also authorized to issue special permits.

This discussion focuses on zoning as it regulates various aspects of land development which tend to have negative impacts on water quality. In particular, the potential problems previously discussed, particularly non-point sources, can be controlled and even prevented by the application of the following zoning regulations.

The material discussed here is organized around three types of zoning regulations.

- Six natural feature districts which are related to particular geographic areas having direct relationship to the protection and maintenance of water quality.
- The application of land use and density regulations, as well as clustered development practices, as they relate to water quality.
- A group of development regulations which can be useful at the site level for insuring the development is situated on the land in a way which will minimize negative water quality impacts.

1. Natural Feature or Resource Districts

Wetlands, floodplains, aquifer recharge areas, water bodies and courses all are closely related to the natural functioning of the hydrologic cycle. The disruption and disturbances of such environmentally sensitive areas result in significant water quality and water quality-related problems. Zoning regulations can include districts intended to specifically protect the hydrologic functions of these areas.

It may be helpful to differentiate between "base" and "overlay" zoning districts and to make a point about mapping. For the most part, the type of resource districts discussed in this section are drafted in bylaws or ordinances as "overlay" districts (not "base districts"). In other words, they overlay or are superimposed on the existing residential, commercial or industrial use districts. The natural feature or resource district normally contains additional requirements on the development that may occur in the delineated areas. Special wetlands, floodplain or aquifer recharge area maps are usually made part of such zoning regulations in order to delineate, as precisely as possible, where the more restrictive requirements apply. As a general rule pertaining to wetlands, floodplain and aquifer recharge zoning, the more complex the regulation, the more accurate the map and data necessary to meet technical challenge.

1a) Wetlands district - The basic purpose of a wetlands protection district is to ensure that the critical natural functions of wetlands are maintained. These functions include water supply, flood control, entrapment of sediments and other pollutants and protection of wetlands vegetation and wildlife habitat.

Any development activity which necessitates extensive site modification should be prohibited in delineating wetland areas. Filling, dumping, dredging, paving, construction of structures or sewage disposal systems, and storage of salt, petroleum products, chemicals and similar substances would not be permitted. Permitted uses might be activities related to hunting and fishing, types of agriculture not requiring fertilizers or pesticides, and certain other conservation or recreation uses not inconsistent with the purposes of the law.

If a special permit procedure is used for development activity in wetland districts the bylaw "must provide adequate standards for the guidance of the board (or special granting authority) in deciding whether to grant or withhold special permits..."[1], the bylaw may confer some measure of discretionary power to the special permit granting authority but it must not confer "unrestrained power to grant or withhold special permits by the arbitrary exercise of that discretion."[2]

A number of wetlands mapping methods are possible. Air photo interpretation of vegetation, soils and topography is becoming more common. Field checking of the smaller wetlands is often necessary. Compared to maps of floodplains and aquifer recharge areas, wetlands maps are more easily obtainable at a more reasonable cost.

1b) Floodplain district - A floodplain protection district has a twofold purpose:

- to provide public safety protection by affording natural storage areas for floodwaters and thus serving to prevent property damage;
- to prevent possible water quality problems resulting from greater volumes and velocity of stream flow, greater sediment yields, and contamination from urban runoff and sewage disposal systems.

As in wetlands zoning, any development activity which necessitates extensive site modification should be prohibited in delineated floodplains. Filling, dumping, dredging, paving, construction of structures or sewage disposal systems, and storage of salt, petroleum products, chemicals and similar substances generally should not be permitted. Conservation, recreation and agricultural activities which do not degrade water quality could be permitted in some areas of the floodplain district. Structures such as backstops necessary for outdoor games, duck blinds and the like are compatible uses. The use of fertilizers and pesticides for golf courses or tilled cropland would have to be carefully regulated, as would all impermeable surfaces. Changes in natural contours and vegetative cover should be kept to an absolute minimum.

Special permits for uses compatible with floodplains should be granted only after an appeal process similar to that described above for wetlands districts.

Accurate floodplain maps require detailed hydrologic and engineering studies. Sometimes these studies are available from a government agency. More often than not, a community has to have such a detailed map prepared with either local or outside professional assistance. In addition to a basic wetlands map, data on high water marks, floods of record and mathematical methods may be used to delineate the limits of, say, the 100-year flood.

1c) Aquifer recharge district - The basic purposes of an aquifer recharge protection district are to assure that underground water supplies are recharged by the infiltration of precipitation, and to safeguard groundwater from contamination.

Requirements to regulate the amount of impervious surface in any development in a recharge area are of primary importance for maintaining infiltration. Minimum lot sizes to prevent the undue crowding of subsurface sewage disposal systems are necessary to avoid potential degradation of water quality. Storage and use of potential contaminants such as petroleum products and de-icing salts should be carefully regulated, and sanitary landfills should not be permitted in aquifer recharge areas. Since drainage is of particular concern, special requirements for porous pavement or gravel driveways, open watercourses, recharge basins, and dry wells can be part of an aquifer recharge district in order to promote maximum infiltration and minimum runoff.

A base district of one to two acre residential minimum lots on the higher yield aquifers might be appropriate, with all other uses and activities requiring a special permit. Site plan review requirements regulating all uses including those permitted in the base district, could serve to minimize interruption of an aquifer's recharge function. Where sewage disposal facilities other than subsurface septic systems are available, cluster provisions could permit higher residential densities. If the development is to be served by subsurface septic systems or a communal system, cluster provisions could also be used to control system location to protect the aquifer. (See sections on cluster zoning regulations and site plan review.)

The practice of clustering development should be encouraged in an aquifer protection district so that the total amount of impervious surface is reduced. Wastewater disposal facilities should be installed in a manner that offers the least potential contamination to the groundwater.

An aquifer recharge area is the most difficult to map accurately, principally because the resource to be protected occurs beneath the earth's surface. Permeable soils such as sands and gravels, which allow water to infiltrate more quickly than other soils, are often a clue to the location of groundwater. However,the professional advice of a hydrogeologist and perhaps even test wells are necessary before a map for zoning purposes can be drawn. The higher yield aquifers are more important to protect than those which afford lower yields of drinking water. The nearer an aquifer is to the surface, the more vulnerable it is to contamination.

1d) Stream buffers - The purpose of buffers along streams and around lakes and ponds is to preserve and protect the filtration and purification function of land bordering watercourses and water bodies. The regulatory mechanism to protect this sensitive natural feature could be either a district delineating particular areas included in the buffers or a definition could be specified establishing a particular setback from streams or water bodies.

In the designated buffer, development requiring extensive site modification would not be allowed. That is, uses or activities involving disturbances of the soil, vegetation, or the bank of the stream or lake; or activities posing the threat of biological, chemical or physical water pollution would be prohibited. Conservation and recreation would be the only permitted uses, with agriculture a possibility depending upon the runoff characteristics of particular tilled or grazed land and the extent to which fertilizers and pesticides would be used in the farming operations.

A buffer or setback, of say, 100 feet from all streams, brooks, lakes and ponds could be designated either as a separate zoning district or as an addition to an existing wetland or floodplain zoning district. The advantage of designating such buffers is that the area to be regulated along watercourses and bodies may not be either a wetland or a floodplain. Depending upon local conditions of slope, soil and vegetation, more or less than 100 feet may be required to preserve the filtration and purification function.

1e) Watershed protection district - The basic purpose of a watershed protection district is to protect reservoirs, lakes and ponds from contamination by regulating development in the immediate watershed of such water bodies.

Two levels of protection could be delineated: one for the regulation of development in the watersheds of reservoirs, and the other for lakes and ponds used for conservation, recreation or other purposes.

In the first case, any development requiring extensive site modification would not be permitted. In the second case, the density of septic systems should be controlled by minimum lot size requirements minimizing the eventual concentration of nutrients. Even when subsurface sewage disposal systems are functioning properly, this concentration contributes to the eutrophication process of lakes and ponds. If such watersheds are later sewered, runoff from impervious surfaces, erosion and sedimentation, use of fertilizers and pesticides — in fact any change in natural contours and vegetation — is likely to result in some negative change in water quality. Therefore, the watershed of each specific lake and pond needs to be regulated according to the degree of urbanization and existing land uses, the natural characteristics of soil and slope, the assimilative capacity of the water body, and its existing and intended use.

1f) Water resource protection district - Wetlands, floodplains, aquifer recharge areas, buffers and watersheds could be included in a comprehensive water resource protection district (in contrast to a separate district for each natural feature area). The purpose of such a comprehensive zoning district would be to protect the system of surface and groundwater from adverse water quality impacts in a rational, coordinated manner. This comprehensive approach to water quality protection involves delineation of all natural features requiring protection and avoids overlapping regulations which could occur when using separate districts.

Within a comprehensive water resources protection district, permitted uses in separate districts would follow the same criteria previously described and would also be regulated similarly.

2. Use and Density Regulations

Zoning normally regulates the use and density of land development, and the establishment of minimum lot sizes is a common technique to determine development density. Most commonly, minimum lot sizes are associated with residential land uses, although these minimums can also be used with commercial and industrial land uses.

In order to establish densities of development that do not have adverse impacts on water quality, the natural capacity of the land should be the basis for the minimum lot requirements and waste disposal facilities and water supply.

An example of the application of this type of regulatory technique can be seen in the case of residential development requiring individual subsurface disposal. The lot size appropriate for such development should be determined by the permeability of various soil types, the area necessary for alternate leaching fields, the slope of the land, the proximity to surface or groundwater, etc. When the development is using an on-lot well, the distance and location between the well site and the waste disposal facility must also be taken into account in determining the minimum lot size.

3. Cluster and PUD Regulations

In regulating the most appropriate type of development and the suitable density of development, a town could utilize cluster or planned-unit development (PUD) approach. Cluster development regulation is more flexible than traditional zoning in that it permits developers of relatively large sites to deal with the entire site as a unit rather than dealing with a number of separate lots. The overall density of the development remains constant in a cluster development, but the distribution of the units is altered.

Unlike a traditional form of development which uses a standardized grid-pattern development, the cluster technique allows the units to be clustered together, while a significant portion of the land remains undeveloped. Therefore, environmentally sensitive areas including steep slopes, outcrops of bedrock, wetlands remain as undeveloped open space, thus protecting water quality. At the same time, the more permeable soils could serve the development's septic systems. Since the total length of access roads and driveways tends to be shorter under cluster development, the amount of impervious surface is decreased and runoff problems are reduced.

PUD allows a clustered, residential pattern with a mixing of some commercial or light industrial land uses in the same development. This type of regulation offers similar advantages to a community as does residential clustering, by allowing flexibility in the siting of a large development and a reduction in the total amount of streets and impervious surfaces.

Under the Zoning Act, zoning ordinances and bylaws may provide that cluster developments or PUD's shall be permitted upon the issuance of a special permit,[3] thereby allowing for review of this type of development on a case-by-case basis.

4. Site Plan Review

The recently modified Zoning Act encourages and expands the use of special permits and site plan reviews. Site plan review is a planning and design technique whereby land developments may be evaluated and special permits may be granted.

This technique is utilized by many communities to allow a more detailed review of the siting of particular land uses which exhibit potential for requiring additional municipal services. This type of review often focuses on vehicular parking and loading requirements as well as the provision of screening and visual buffers. A logical additional application would involve carrying its use beyond visual and traffic safety purposes to protect water quality.

The site plan review requirement could be written to apply either to particular land uses or to a specific geographic area. For example, the regulation could either stipulate the specific types of land uses which have a significant potential water quality impact and require a site plan review, or the regulation could be such that all development which occurred in a specific environmentally sensitive area would require a site plan review.

The information to be supplied with a site plan is important from a water quality standpoint. In many respects, the natural feature data regarding the site, along with construction plans and specifications, should be similar to the information available for subdivision review.

Besides providing the data concerning the natural features of the site, the site plan review process should include an erosion and sedimentation control plan for the construction phase of the work and also as a permanent aspect of the development.

The parking requirement aspect should be broadened to include effects of impervious surfaces on drainage and recharge. Data required to be submitted with both site and subdivision plans should include but not be limited to the following:

- existing and proposed contours and grades
- existing and proposed vegetative cover
- existing natural drainage, including runoff/infiltration ratio
- proposed natural and improved drainage system
- erosion and sedimentation control plan (during and after construction)
- existing municipal water, sewerage, and drainage facilities within specified reasonable distance of site
- proposed provisions for water and sewerage facilities
- soil type(s) and general soil limitations for septic systems

- soil percolation rate(s) and depth to seasonal high groundwater
- existing water bodies, streams and wetlands within specified reasonable distance of site
- distance from 100-year floodplain and aquifer recharge area (as appropriate)
- existing and proposed system of roads, including traffic volumes
- proposed provisions for off-street parking and sidewalks

Various municipal bodies could have various roles in reviewing such information, although the new Zoning Act explicitly states that only boards of zoning appeals, boards of selectmen, city councils, zoning administrators or planning boards may act as special permit granting authorities. (The role of various local boards is somewhat more standardized under subdivision control and will be more fully discussed later in this report.)

5. Site Development Regulations

Specific portions of a community's zoning regulations should be oriented to the possible effects of development on water quality. Grading and slope regulations, minimum open space requirements, and parking regulations are all important in the protection of water quality. These three regulations can be included in the zoning regulations in any of three forms. They can be written to apply to a specific type of land use activity on a community-wide basis; or to apply to specific permitted uses in designated districts; or to apply to any land development in a particular environmentally sensitive area, for example an aquifer recharge area. Also two additional zoning regulations are discussed here which apply to earth removal and the storage of salt and potential contaminants. These two regulations can either be incorporated in the community's zoning regulation or as separate municipal bylaws or ordinances.

5a) Grading and slope regulations - The grading and slope regulations minimize runoff and erosion from any given site, maximize infiltration into the ground and, more generally, protect the quality of surface and groundwater.

Grading and slope standards can be written to apply to development on all land over a specified slope, or they can be drafted to apply to all land development within a specified area, such as a watershed protection district.

The standards define maximum finished slopes and grades, and specify land management practices during and after construction in order to reduce water runoff and soil erosion. Standards for the maintenance and restoration of vegetative cover could for example be included in such regulations. The use of artificial, impervious or steep slopes could also be regulated through the use of grading and slope regulations.

5b) Minimum open space requirements - Open space requirements currently used often relate to the maximum building coverage permitted on individual lots and, in a limited number of cases, minimum open space requirements are used in conjunction with coverage regulations. These open space requirements could be used to preserve natural drainage patterns and to protect the recharge function over high yield aquifers by the retention of land in its natural state. The amount of impervious area is the key measurement in the open space regulation, with only those areas that permit natural drainage and recharge considered as open space. This does differ from building coverage requirements which are more oriented to the adequate provision of light and air and which do not regulate the extent of driveways and parking areas.

5c) Parking area regulations - Parking regulations are currently contained in most zoning regulations for off-street parking requirements, although these generally regulate only the amount of parking area. From a water quality perspective, such requirements should be expanded or modified to include regulations on natural drainage and infiltration for the purpose of reducing stormwater runoff and protecting water quality.

Parking area regulations could address quantity of impervious surface, on-site drainage of impervious surfaces, and maintenance of the process of infiltration. Requirements for maintenance of natural vegetative cover or for planting of new vegetation around all parking areas could also be included, as well as the encouragement of using porous pavements or gravel surfaces, where appropriate.

5d) Earth removal regulations - Many cities and towns already regulate earth removal either through zoning regulations or under a separate ordinance or bylaw. Such regulations can be expanded explicitly to include water quality concerns. In addition, sufficient data on natural features and resources should be included in applications for earth removal permits, so that the potential effects on water quality can be reviewed.

Earth removal operations should not be permitted in proximity to either surface or groundwater. Requirements for both temporary and permanent drainage should be submitted as part of a site plan review process. Restoration standards dealing with contours, slopes and grades should be included to minimize eventual runoff problems. Erosion should also be minimized by requiring replacement of soil and vegetation of a quantity and quality at least equal to that found on the site in its original state.

5e) Storage of salt and other potential contaminants - The improper storage and use of de-icing salts, petroleum products and other toxic or hazardous materials present especially difficult water quality problems. Substantial degradation occurs if they find their way into water bodies or courses. Examples of these materials are salts and de-caking compounds used for snow and ice removal, fuel and other petroleum products, fertilizers and pesticides, and chemicals used in standard construction practices.

Storage regulations require that such materials be maintained in temporary or permanent structures or other enclosures such that no leaching into the ground or runoff would occur. For example, de-icing salts should be stored in wooden sheds or covered bins, and fuel should be stored in non-corrosive fiberglass tanks in aquifer recharge areas. (Certain operations such as automobile salvage, should not be permitted at all over aquifers because of the potential for hydrocarbon and toxic waste contamination.) These regulations can establish conditions for the manner in which any potential contaminants are to be stored, or they can delineate those environmentally sensitive areas in which such materials should not be stored.

Subdivision control - With the exception of zoning, subdivision control is the most widely employed local land use regulator. The review of a subdivision plan occurs at a key point in the process of local land development. Given certain use, density and other requirements to be met under zoning, a subdivision plan (or site plan required for a special permit under zoning) represents how a particular development proposal will be fitted to a specific site. In many cases, it is the first indication to local officials of the full impact a proposed development will have upon their community. If properly utilized, this review process can also indicate the possible detrimental influence of proposed development upon overall water quality.

Under the Subdivision Control Law (Chapter 41, sections 81-K to 81-GG, of the Massachusetts General Laws) municipal planning boards are empowered to adopt and amend local subdivision rules and regulations. The enactment of such rules and regulations does not require action of town meeting nor of city council. The procedural requirements are that the planning board hold a public hearing, and that the rules and regulations be transmitted to the city or town clerk and the appropriate register of deeds. Substantively, local subdivision rules and regulations cannot be inconsistent nor in conflict with the Subdivision Control Law.

It should be noted that all subdivision rules and regulations "should be comprehensive, reasonably definitive and carefully drafted, so that owners may know in advance what is or may be required of them and what standards and procedures will be applied to them."[4] If regulations are vague and ambiguous they will be difficult to uphold.

Several major techniques which communities can utilize to maximize the effectiveness of subdivision control in protecting water quality are discussed as follows.

1. Data Requirements

A subdivision plan submitted for local review should be required to include an inventory of the natural characteristics of the land to be developed. Proposed alterations to this natural landscape, as well as the anticipated effects of these changes should also be submitted. If provided in sufficient detail, this information will enable a community to assess possible negative water quality impacts from the planning, design and construction stages of subdivision development. Examples of data necessary for inclusion are:

- plans and specifications
- existing and proposed contours, grades and vegetative cover
- existing and proposed natural storm drainage
- an erosion and sedimentation control plan
- existing and proposed water supply and sewerage facilities
- soil type and limitation for on-site disposal
- soil percolation rates and depths to seasonal high water table
- existing water bodies, streams and wetlands both on and within a reasonable distance of the site
- distance from the 100-year floodplain and aquifer recharge area (as appropriate)

2. Erosion and Sedimentation Control Plan

The natural processes of soil erosion and sedimentation area closely related to drainage characteristics, storm water runoff and water quality in nearby surface waters. Local subdivision regulations should protect natural land drainage by:

- Allowing development to occur with only minimal disturbance to natural topography and vegetation.
- Requiring the prompt restoration of natural vegetation following construction.

Specific measures to control erosion and sedimentation during and after construction include:

- Use of sediment basins and traps as well as filtration barriers to collect runoff.
- Use of diversions, interceptor beams, bench terraces and permanent vegetative cover stabilization techniques to slow runoff, thereby preventing erosion of hillsides.
- Completion of required storm drainage systems during the first phase of construction.

To provide adequate drainage and to avoid the threat of flooding, these measures should be included in a sedimentation and erosion control plan, which specifies the location and timing of their use, and submitted as part of the overall subdivision control plan.

3. Environmental Impact Review

In order to be able to fully assess the impact of large-scale development, environmentally as well as financially, a requirement should be drafted at the local level requesting developers to submit an environmental impact report as part of the subdivision approval process. Such requirements need not apply to all subdivisions, only those large-scale, subdivision developments of community-wide or regional significance or those occurring in an environmentally sensitive area. This comprehensive statement of potential impacts of a proposed development will help a community in areas of concern beyond natural resource protection. It offers a useful tool for review of off-site and on-site effects of a large-scale development.

4. Local Coordination

The subdivision review process should afford an opportunity for a coordinated and cooperative effort by local boards and commissions. Conservation commissions and boards of health, as well as the planning board and other municipal bodies are involved in one aspect or another of approving local land developments. It is an appropriate opportunity for local officials to take a comprehensive view of the proposed development to determine its overall effect on the community, particularly in terms of avoiding future problems associated with the provision of municipal services or in correcting adverse impacts.

It must be remembered, however, that "all health questions with respect to the disposal of sewage in a subdivision which will not be connected to a municipal sewer is vested exclusively in the board of health."[5] Furthermore, the planning board's regulations and determinations are not controlling where they are inconsistent with other boards or agencies of the town "in matters as to which such agencies have independent responsibility,"[6] such as providing municipal water or sewers. However, many of these jurisdictional dilemmas can be overcome if planning boards require the applicant to show that he has perfected all necessary arrangements with these other boards. (The coordination and possible streamlining of the subdivision review process is more fully discussed in Chapter 6.)

Innovative Controls

1. Performance Standards

The traditional form of zoning regulation is based on the establishment of discrete districts which permit specified land use and also prohibit or exclude certain activities. This approach to the regulation of land use activities developed from legal antecedents which sought to exclude or regulate specific land uses as nuisances. This concept of nuisances remains implicit in the rationale for creating zoning districts for a community. One consequence of this type of zoning, which relies on prescriptive districts is that, in order to make a district comprehensive enough to insure the prohibition of all possibly undesirable activities, inoffensive land uses are also eliminated from use in the district.

Dissatisfaction with the rigidity of traditional "use zones" and the resultant separation of land uses has fostered increased interest in the concept that land use regulation should be related, not to the land use alone, but rather to the effect of the land use. The idea of regulating uses by their external effect rather than by their name led to the development of performance standards. The use of performance standards means that the offensive characteristics of a particular use will be prohibited from a district, rather than banning the use itself.

If a regulatory approach uses performance standards, the description of a district is usually characterized by a list of uses that are permitted within a particular district if they meet specific conditions that are more or less scientifically measured. For example, an ordinance may establish an industrial zone and provide that any industrial use is permitted if it does not emit smoke or create noise beyond a specified measure based on a scientific standard. Other standards will be included to measure vibration, dust and other particulate matter, odor, toxic and noxious matter, fire and explosive hazards, humidity, heat and glare, radiation hazards, landscaping, enclosed parking, screening, etc.

Certainly the standards used as criteria in determining how activities must perform in particular areas of town should cover a broad spectrum of possible effects. In addition to the type of standards mentioned above, other criteria such as traffic generation, intensity of the development, or economic impacts would be likely criteria found in a regulation utilizing performance standards, and water quality standards could also be employed in this manner. One example of how a water quality related standard might be utilized in this type of an approach can be seen in regard to drainage and recharge. The regulation would contain standards for the maximum off-lot drainage permitted to take place in conjunction with any development or conversely, a minimum standard for on-lot recharge would be included which must be met by any development proposed for the area so regulated. Those land use activities which could meet the criteria established in this manner would be seen as having no negative effect on the area and therefore would not be excluded.

Currently there have been few legal challenges to the concept of performance standards. This is certainly true in those instances where there is a fairly strong scientific basis for the standards and where the language of the standards does not grant excessive discretion to the administering agency. By establishing measurable and specific criteria which are used in evaluating possible development, the approach of performance standards may reduce potential problems arising from the arbitrariness of administration.

As is true with any approach offering increased flexibility, a system of performance standards may place increased administrative requirements on those responsible for the execution of the regulation. The drafting of this type of regulation may require additional expertise, since in order to achieve the maximum benefits from this type of approach, the standards should be designed for the specific situation of a community and not adopted in toto from models or those being used by other communities. The administration of such regulations by the zoning authority may involve a more detailed data base or more data on each development as it is proposed.

2. Growth Management

Traditionally, in the field of local land use regulation, the techniques employed have not generally been directly oriented to the issue of growth. Rather, mechanisms have been used which are directed at the type of development that is occurring within the community. It has often been the philosophy of land use regulation that by controlling the type and quality of development, the community would be handling the issue of growth.

Recently, as communities have experienced periods of rapid growth, traditional regulatory mechanisms have seemed to be inadequate in allowing towns to manage their growth. Rapid growth has meant that the town's services and facilities have been overburdened, and that the demand for additional services has placed significant financial pressure on the communities.

The demand for services and facilities began to indicate that it was not entirely the type of development creating the difficulties but rather the pace or rate of growth in the town. Often growth was occurring rapidly and creating difficulties, while if this same amount of development had taken place over a longer time span it could have been more easily assimilated by the community.

More recently communities have begun to use or consider a type of regulation which does address the issue of growth directly. This type of regulation is concerned with the amount of development which occurs, plus the sequencing or timing of development. As a group, this type of regulation is referred to as a growth management system.

There are several types of growth management or phased growth systems, which have received substantial coverage in recent years. Often each type of approach became identified with the particular community in which it was first applied. Regardless of differing aspects of the approaches, they do have a common purpose — that of regulating the amount or timing of new development, thereby exerting control over the rate of growth.

Growth management systems allow development to occur at a rate which does not place undue burdens on municipal services by allowing development to be assimilated into the community. It affords the municipality the opportunity of rationally planning for the accommodation of growth on a long-term basis and reduces the necessity of short-run decision-making.

A typical regulation aimed at controlling the timing and sequence of future growth is often based on a comprehensive plan for the town and also involves an adopted capital improvement program which projects the staging and sequential provision of necessary municipal services to all areas of the town. This data provides the framework for the rational accommodation of anticipated growth. Further development must occur within the framework established by the community. Anyone wishing to develop land must do so in accordance with the comprehensive plan's and capital budget program's scheduling. This type of approach grants permission to develop land on a rating of point system in which a proposed development receives points by having adequate provision of a variety of necessary services. Such services could include sanitary facilities, drainage facilities, parks and recreational facilities, schools, roads and transportation facilities, etc.

Regardless of the particular aspects of each type of growth management system, they do share some common points.

- They attempt to ensure that future growth will be adequately planned and provided with the facilities and services necessary. This organized delivery of services can result in reducing the cost to the municipality by properly coordinating the construction of capital improvement projects.

- They all provide an alternative to a spiral and leapfrogging of future growth. This alternative can result in increased protection to the town's environment, in the prevention of damage to sensitive or critical environmental areas, and in an increased level of environmental amenities.

- This type of regulatory system also offers some predictability to both the town residents and investors as to when certain portions of the community will develop and when municipal services will be available.

However, these regulations do present some difficulties which should be considered when deciding to utilize them. An important consideration is the initial cost to the locality. Since the development and implementation of such regulations requires substantial comprehensive planning and capital improvement programming expertise, an increased level of local spending while studies are being conducted should be expected.

This type of control for staging growth can temporarily convey increases in value to some lands, and conversely, losses in value to other lands. Provisions must be made to ameliorate such losses, such as reduced tax assessments. If this regulation had the effect of substantially curtailing development and, as a result, the assessments on undeveloped property were reduced accordingly, the impact on a small town could present some financial difficulties.

3. Transfer of Development Rights

Land use regulations typically impose limitations on the expectations of individuals to develop their land as they wish, sometimes directly confronting the individual's economic motivation to profit from the use of his property. Despite this, typical regulations make no provision for compensating those whose land is regulated. With each tract of land regulated, therefore, some loss in value is ordinarily imposed, without compensation, in the furtherance of the public health, safety, and the general welfare. The immediate and obvious impact is usually to diminish the value of privately owned property. A pervasive effect of the zoning process is that large increments of land value are destroyed, created, transferred and conferred. This occurs without any effort being made or mechanism being available to adjust the highly disproportionate land valuations that are produced.

Communities which have attempted to restrict the use of certain natural lands, for example, realize that regulations which prohibit all use of the land are often challenged on the basis that they deprive the owner of his property rights without compensating him for the loss. The technique of transfer of development rights (TDR) attempts to bridge this gap between private property and public regulation. TDR is based on the notion that landownership consists of a bundle of rights which can be separated and sold individually. In other words, an owner of land can separate his right to develop the property from his other rights (e.g., access, agricultural use) and place a value on that right.

While there are many variations of how a system of transfer of development rights could operate, a general system can be sketched here to indicate how a program might operate to protect water quality. The jurisdiction within which the TDR system is to function would prepare a comprehensive plan designating areas within the community to be developed as residential and commercial (development zones) and areas to be kept as open space or rural-agricultural fringe lands (restricted areas). Restricted areas would be water-related lands or critical areas such as wetlands or aquifer recharge areas which, according to the community's comprehensive plan, should be regulated in order to safeguard water quality. Development zones would be areas of the community that were served by municipal services (sewer and water) and which were able to support relatively high densities of development without threatening water quality or other environmental degradation.

Central to the concept of TDR is the notion that development rights can be transferred from one parcel to another. In this example, the owner of the land in the restricted zone could sell (thereby transferring) his rights to an owner of land in the development zone. Both parties would stand to gain from such an arrangement. The owner of the restricted land (which might be a wetland for example) cannot use his development rights on his own property due to the regulations that have been applied, yet he can profit from the land by selling his rights. He also receives a tax advantage since his land is now re-assessed at a lower value, reflecting the elimination of the right to develop his property. The owner of the land in the development zone on the other hand can develop his property at a certain density under current zoning, yet if he purchases development rights he is allowed by the town to build at higher densities than would otherwise be permitted. Therefore, it is to his economic advantage to purchase the rights.

A system of development rights transfer would require more administrative expertise than some of the more traditional regulatory techniques discussed earlier in this chapter. Being a more complex system of regulation, a transfer of development rights scheme might not be suitable for all communities, but its advantages make it an attractive proposal for certain municipalities. One advantage of this type of approach is the fact that except for initial costs in increased planning studies and determination of the number of rights to be assigned to certain properties, there is no on-going cost to the municipality except for administration. The private market conducts the transactions for compensation to landowners and acquisition of necessary development rights, while the community receives the beneficial effects of the spatial location of the development. More importantly from a water quality perspective, this type of system allows a community to protect critical water and land resources while accommodating desired commercial, industrial and residential growth.

C. ADDITIONAL MANAGEMENT PRACTICES

Local health codes-The State Environmental Health Code, Title 5, establishes minimum standards for the installation and operation of septic systems. While all communities are required to meet these standards, they are permitted the option of adopting a more stringent local code than that established by the state.

Communities should establish more stringent standards where the natural conditions of an area require them. Development of these local codes should be based upon the natural resources information concerning an area and should be oriented to the principle that the use of septic systems should not exceed the natural capability of the soil and the environment to accept development without degradation to water quality.

Acquisition of land - One of the most effective means of protecting critical environmental lands from development is outright purchase of the parcels in question. Local regulatory controls discussed thus far are based on the assumption that sensitive environmental areas will remain in private ownership, and thus the uses to which they are put must be regulated so as to prevent water quality problems. Obviously, if these lands are in public ownership these regulatory programs are unnecessary.

Many communities have active conservation programs, and many environmentally critical lands including wetlands, floodplains, shorelines of water bodies, and watersheds of reservoirs have been protected through acquisition. The obvious drawback to these programs is expense. Land costs are high and are steadily rising. As a result, communities must often look to less expensive methods of protection.

Partial acquisition is an option which is less expensive than full purchase, and affords a high level of protection. A community can purchase easements on property and thereby prohibit certain activities from occurring.

Rights of ownership are, in effect, separated. For example, the community purchases the rights to develop the land, while the private owner retains the remaining rights. Partial purchase is less expensive than full ownership (though in some cases not significantly so).

(Readers interested in a full description of funding programs for acquisition of land, primarily open space, should consult MAPC's "Open Space and Recreation Plan for Metropolitan Boston, Vol. 1, (revised), 1976," pages 105 through 108.)

Conservation restrictions - Under Massachusetts law (Chapter 184, s.31-33 of the General Laws) private property owners may relinquish certain property rights and thereby ensure that the land will remain as undeveloped open space. No payment is made to the private owner. His or her incentive is usually tax-related. The owner and the community (or other body) agree to certain restrictions on the land — which can include restriction on all development, on dumping, removal of vegetation, excavation, activities which would be detrimental to natural drainage or water conservation, or which would contribute to erosion problems. With the imposition of these restrictions, the land's value is lessened, and it is re-assessed at a new value. The use of conservation restrictions is also attractive to the community in that it offers protection of critical environmental land at a low cost.

Wetlands protection - Massachusetts General Laws provide for two programs of wetlands protection. Under Chapter 131, section 40, local conservation commissions are empowered to review all proposed development of wetlands areas within their town boundaries. If a proposed development is to occur on land which is significant to water supply, flood control, prevention of pollution or other factors, the commission may stipulate the conditions under which the development may take place. Appeals are made to the state's Department of Environmental Quality Engineering (DEQE).

Under Chapter 131, therefore, permits are granted by a local board after the developer has expressed a specific intent. Under another section of the General Laws (Chapter 130, section 105 and Chapter 131, 40A) restrictions are placed on the land before development is imminent. Under the Coastal Wetlands Restrictions Act and the Inland Wetlands Restrictions Act, the commissioner of environmental management may issue orders regulating the use of certain wetlands in the state to ensure that they will remain in a natural state.

D. WATER CONSERVATION

Many solutions to water pollution discussed earlier in this chapter require monetary expenditures, new construction, or modification of existing laws. Yet, there is one very simple preventative solution each of the region's three million people can practice - water conservation. There are, in fact, a number of relatively inexpensive and simple ways to conserve water which, according to the Massachusetts Water Supply Policy Study, may save 15 to 20 percent of the total water consumed. (Other groups expect that even more savings can be achieved.)

Each day the average family uses 175 gallons of water. Nearly all of this water is discarded as wastewater to either a sewer connection, or to an on-site sewage disposal system.

A reduction of the total amount of water used can have important implications. First and most importantly, less water used in the home means less sewage generated since sewage is 99.9 percent water by weight. This reduction of wastewater in many cases means that sewage treatment plants are better able to handle peak flows. The MDC sewage treatment facility at Nut Island, serves as a good example. The existing capacity of the plant is insufficient to handle the large volumes of sewage that it receives during peak flows. As a result, raw sewage is frequently discharged into Quincy Bay.

Less water consumed may also mean better functioning of septic systems, as leaching beds are less likely to be overloaded by an excessive volume of wastewater. The economic benefits of water conservation, in other words, appear in smaller sewer and water bills, less need for costly sewage treatment plants and in improved water quality.

The most significant water conservation measures for the average home would be those reducing the amount of water used by toilets, baths and showers. Recent eastern Massachusetts' studies indicate the following breakdown of average household use:

Toilet flushing	41%
Bathing	35%
Cooking, washing	10%
Drinking	5%
Clothes washing	5%
Lawn sprinkling	3%
Car washing	1%

Water consumption in the average home can be easily reduced, without sacrifice, in a number of ways. Existing home equipment, for example, can be modified. Devices are available commercially, for less than $10.00, which easily fit into a toilet tank and decrease the amount of water needed (by as much as 50 percent) without lowering pressure. The consumption of water from showers can also be significantly reduced by other low cost mechanisms. These regulators are added at the shower nozzle and permit the adjustment of water volume without changing water temperature. Volumes of water can be reduced by 40 percent and equivalent savings in water heating can also be realized.

New homes can be easily equipped with water-saving equipment at no greater cost to the homeowner. Water-saving toilets, for example, can reduce water consumption from between 50 to 100 percent. Water-saving showerheads can save up to 75 percent of the water normally used while also saving on heating costs, and water-saving laundry machines can also save up to 25 percent in water consumption.

The success of any water conservation program depends on people. Water conservation need not be totally voluntary. It can be encouraged, or even enforced on a community-wide level. Local regulations may require conservation of water, or community subsidized programs have in some towns provided water-saving devices for residents. (The benefits which accrue to the community from such a program will likely outweigh the costs.) Water conservation is also encouraged through economic means via water metering and appropriate pricing. Many communities in Massachusetts have adopted rate pricing which eliminates discounts to large volume users.

Any or all of these methods can be used successfully in efforts to reduce water consumption. A program of water conservation can have a number of desirable outcomes: economic benefits will be realized, water quality will likely improve, and our most precious natural resource will be conserved.

B. WASTEWATER CONVEYANCE, TREATMENT AND DISPOSAL

A. TECHNOLOGICAL WATER POLLUTION CONTROL ALTERNATIVES

The following sections outline a range of alternative structural and non-structural solutions available to adequately treat and dispose of the wastewater from an individual home, community or a number of communities with a common problem. This discussion is intended to provide a background for the decision-making process involved in selecting safe and cost-effective treatment methods of wastewater prior to its disposal into the environment.

Wastewater classification

1. Black Water

Black water is composed of the sanitary wastes deposited in the toilet. Major components are human urine and fecal material. This portion of the waste is characterized by a high organic load, a relatively low solids load, high concentrations of ammonia, trace quantities of essential elements such as iron and magnesium, and large bacterial and viral populations. In addition to the organic, or human, portion of black water, there are a number of inorganic articles which constitute the second fraction of black water wastes. The articles include toilet paper, disposable diapers (sometimes indisposable diapers) and sanitary napkins. These materials contribute a high solids load, a fairly low organic load and add to the bacterial and viral populations. Typically, small quantities of human waste are flushed from the toilet with a large quantity of clean water which dilutes the waste and makes it amenable to gravity flow transport out of the home for disposal. Black water accounts for approximately 40 percent of the wastewater generated in the home.

2. Grey Water

Grey water consists of the water used in the laundry, bathtub, kitchen and bathroom sinks, plus dishwashers and other appliances. This water contains cleaning and washing agents (e.g., soaps and detergents) together with organic and inorganic matter from the items washed. A small bacterial and viral population is also present. Grey water is characterized by high phosphate and sodium loads, grease and oils, and surfactants. It constitutes approximately 60 percent of the wastewater from the home.

3. Sewage

Sewage represents the combination of black and grey water in the same system of pipes, transporting the wastes from the home to the disposal and/or treatment location. Domestic sewage is characterized by high organic, solids and nutrient loads, detergents, metals and inorganic salts, and large bacterial and viral populations. Typically, wastewater leaves the home as sewage. Therefore, most of the currently available and implementable methods for treatment and disposal of wastewater are designed for handling sewage.

Methods of disposal - The initial breakdown of types of disposal systems as a function of their location can be simply described under the two headings of on-site and off-site. Under each of these headings, systems are then described as a function of the type of treatment provided and the type of waste being treated, in addition to consideration of residuals to be disposed of following wastewater treatment.

1. On-site Systems

Conventional on-site systems currently available for use are designed for the treatment of sewage. Septic tanks are the most widely used on-site systems. (Due to the inadequacy of cesspools they are no longer considered a viable alternative for sewage treatment and disposal.)

In addition to septic tanks there are several types of on-site systems recently introduced to the American public. These systems are designed to treat black water and grey water separately. However, the systems are presently non-implementable in Massachusetts due to current regulations. However, such systems have been shown to be technologically feasible and environmentally sound and are included in this discussion as valid, if not yet implementable, alternatives.

1a) Septic tank systems - Septic tank systems generally consist of a single water-tight tank and an absorption, or leaching field. The purpose of the tank is to separate the settleable solids and the floating grease and scum from the liquid portion. The solids and grease are held in the tank where they undergo anaerobic (septic) digestion while the liquid effluent is discharged through the underground leaching field system, where it is further treated by interaction with the soil, prior to its infiltration to the groundwater system.

The material left in the tank is referred to as septage. This material must be pumped out of the tank periodically in order to maintain a well-functioning system. Septage is an extremely noxious material and is particularly foul smelling. It generally consists of 80 percent liquid and 20 percent solids and grease. In order to ensure protection of the environment and public health, septage must be treated and disposed of in a safe and proper manner. Methods for the treatment and ultimate disposal of the solid and liquid fractions of septage are presented in the section on treatment in this chapter.

1b) Innovative on-site disposal methods - Most of the so-called "innovative" on-site disposal systems recently introduced to the American public have in fact been in use in Europe and other countries for centuries. Most of these systems are designed to deal only with black water. The most common system is the composting toilet. The compost toilet relies on aerobic digestion of the solids, a process requiring that the liquid portion of the waste be evaporated. Digested solids are suitable for use as lawn or garden fertilizer. Gases produced during the decomposition process are vented into the atmosphere.

One shortcoming of this system is Massachusetts' climate. Due to winter conditions, and wet, humid conditions often experienced during other seasons, evaporation of the liquid portion does not take place. This tends to keep the temperature too low to allow aerobic digestion to take place. This problem has led to the development of the incinerating toilet and toilets which provide a substitute source of heat ensuring evaporation and allow aerobic digestion to continue year-round. Obviously, the addition of a secondary source of heat increases the cost of such systems.

A limitation on the use of these systems is that they deal only with black water generated in the home. Grey water, responsible for roughly 60 percent of domestic wastewater, must still be disposed of.

Furthermore, these systems would require changes in state and local plumbing codes in order to permit installation in the home.

Current research and pilot projects across the nation are beginning to address these issues. At this time, it is too early to discount these systems as viable solutions. They deserve intensive scrutiny for use as a long-range solution to home wastewater disposal.

One innovative technology has been developed to handle both black water and grey water on-site. This is an individual home wastewater treatment plant. It consists of essentially the same processes found in a typical municipal wastewater treatment plant. Although effective, high capital and operational costs, high energy requirements and the need for sludge disposal prohibit widespread use or acceptance of this method.

2. Off-site Systems

Off-site disposal systems typically involve the construction of a sewerage system to carry sewage from the home to the disposal and/or treatment site.

2a) Wastewater treatment plants and package plants - The most common off-site disposal method is a wastewater treatment plant. Package treatment plants are designed to handle much smaller flows than wastewater treatment plants, and provide essentially the same type of treatment. Package plants are generally designed to handle from 10 to 200 thousand gallons of sewage per day. Wastewater treatment plants generally handle flows from 100,000 gpd [0.1 million gallons per day (MGD)] to as much as 600 MGD. These size ranges are equivalent to serving populations ranging from 100 to 2,000 individuals with a package plant and from 1,000 to upwards of six million with a wastewater treatment plant. (Assuming population equivalents at an average waste discharge of 100 gallons per population equivalent per day. This includes an allowance for infiltration and other non-domestic flows.)

Package plants are suitable for use in small communities, large subdivisions or apartment complexes, problem areas within a community, shopping centers and small industries. Wastewater treatment plants are suitable for individual communities or groups of communities and are designed to handle the combined flows of domestic sewage, commercial and institutional wastewater and, on occasion, industrial waste flows. The types of treatment provided by package and wastewater treatment plants is described in the following section. An important factor to consider is that both types of treatment plants are capable of providing very high levels of treatment (at correspondingly high cost) leading to the discharge of an environmentally acceptable liquid effluent and production of sludge which must still be dealt with prior to disposal.

2b) Communal septic systems - With this system, sewage from a number of individual homes is transported to a single, large septic tank and leaching field, usually a short distance from the homes being served. These systems operate in precisely the same manner as the septic systems previously described. As with those systems, the liquid effluent percolates into the groundwater leaving a septage residual to be treated and disposed. At the present time, there are regulatory obstacles to the utilization of communal septic tanks in Massachusetts.

2c) Direct discharges and combined sewers - Two off-site disposal methods no longer acceptable or allowable are direct, untreated, discharges to a receiving water and combined sewers. Both methods lead to gross degradation of receiving waters and to serious public health hazards. These methods have been used in the past for several reasons, including site characteristics precluding use of septic tanks, lack of a community sewerage infrastructure and treatment plant, and the age and density of development in certain areas.

3. Sewerage Systems

An important consideration in off-site disposal considerations is the type of sewerage required to transport the sewage from the home to the treatment location. Gravity flow is the most economical type of sewerage. Many areas, due to topography of subsurface soil and bedrock conditions, are not amenable to gravity flow systems. In such cases, either pumping stations and force mains or pressure sewers must be installed. Engineering practice traditionally has relied on pumping through force mains. However, pressure sewers have been shown in recent years to be an economically as well as technically feasible alternative in many situations. Decisions on the use of one system over the other must be made on a case-by-case basis.

Methods of treatment and ultimate residuals disposal - The foregoing discussion dealt with the alternative methods of disposing of wastewater from the home either on-site or off-site and indicated that all of the existing treatment methods leave a residual which must still be treated before it can be safely returned to the environment.

Septic systems generate septage which must be treated, creating an effluent and sludge. Off-site methods of package and wastewater treatment plants produce treated effluent and sludge. Untreated effluent and sludge both require final treatment prior to disposal.

The purpose of this section is to outline the alternative treatment schemes available to accomplish final treatment and disposal of both the liquid and solid portions of wastewater.

1. Septage Treatment

As discussed earlier, septage is a mixture containing eighty percent water and twenty percent solids. The eight basic alternative methods of septage treatment/disposal are: trench method, landfilling, lagooning, composting, incinerating, separate septage treatment facility, co-treatment at a wastewater treatment plant, and land application.

The trench method (cut and cover) and landfilling (untreated, dewatered disposal in a sanitary landfill) are unacceptable methods of disposing of untreated septage. Both have a high risk potential for groundwater pollution as a result of leachate production, uncontrollable odor problems, and constitute potential public health hazards.

Lagooning (anaerobic system ranging from simple earthen pits to underdrained basins with percolation beds) has been debated at some length as to its relative merits and disadvantages. It is generally considered to be an interim, short-term or stop-gap measure until a more permanent, acceptable solution is found.

Composting is a potentially feasible alternative. Septage is mixed with sawdust, woodchips or other bulking agent and then deposited in piles on an impermeable surface. Biological activity causes decomposition to occur. The resultant product of this activity is an organic mulch which can be used as fertilizer, mulch or soil conditioner. Odor and runoff are potential problems. A large problem in Massachusetts is, again, climate. Temperatures within the compost pile must be high in order to decomposition to occur. Storage must be provided for septage collected when the compost process cannot take place. With further research, composting may be a feasible long-range option.

Incinerating septage usually requires that it be dewatered first. The end product is an inert ash which can then be disposed of in a landfill. High cost is the major drawback to this alternative.

Separate treatment of septage can be done in one of two ways. The first involves complete mix aeration followed by biological stabilization, settling ponds or lagoons and discharge of the effluent either directly to a receiving water or to the ground following sand filtration. The second method involves chemical stabilization with lime. Sludge produced under these methods if then dewatered either mechanically or in sludge drying beds and then either composted, landfilled or incinerated and landfilled. Both of these methods are acceptable.

Co-treatment of septage with wastewater in a treatment plant requires careful evaluation to determine its feasibility. Most, if not all, existing wastewater treatment plants are limited in their design and operational capacities, particularly in terms of solids handling and Biochemical Oxygen Demand (BOD) removal efficiencies. Septage is approximately twenty five times stronger than sewage in terms of solids and seventy times as strong in terms of BOD. Slug loads of septage can cause operational problems in grit chambers and primary settling tanks and can upset secondary biological processes due to the sudden overload. However, current studies indicate that if total septage load is limited to ten percent of daily flow, then most of these problems can be avoided.

Consideration must be given to the appropriate point at which to introduce septage into the wastewater stream. Alternatives include an upstream manhole, primary treatment unit, or directly into the facility's sludge handling process. Further consideration must be given to the provision of septage pretreatment facilities which might be located either at the site of the existing wastewater facility or at a different site.

Co-treatment, and/or consolidation of treatment facilities, is a particularly attractive concept to individual communities and regional systems for a number of reasons. Reduced capital costs can be realized in terms of land acquisition requirements, cost for unit treatment operations and in terms of direct construction costs. Operation and maintenance costs can be reduced because of reduced manpower requirements, lower overall energy requirements and more efficient use of facilities.

Another important consideration is the selection of the method of ultimate disposal of sludge from the combined facility. This is dependent on the character of the sludge generated by the wastewater which will be discussed in an upcoming section.

Land application of septage appears to be both a technologically and environmentally acceptable alternative with minimal pretreatment requirements. Land application can be accomplished by either soil injection or by direct surface spreading. Pretreatment requirements basically involve mixing of large quantities of septage to ensure uniform consistency and "spreadability." Both methods rely on evapotranspiration and percolation for water removal. Bacterial activity causes decomposition of organic matter and plant or crop uptake subsequently utilize remaining nutrients. Land application is more economical than the provision of treatment facilities. However, land application techniques require suitable lands and appropriate land uses (agriculture, silvaculture). Although it may be possible to utilize land application in certain sections of the Boston metropolitan area, there is not sufficient land to accommodate the overall volumes of septage generated.

2. Treatment of Liquid Effluent

Treatment of wastewater to produce an effluent compatible with its intended receiving water can be accomplished in several ways. Public Law 92-500 mandates that all municipal discharges receive a minimum of secondary treatment, or its equivalent, and higher levels of treatment where necessary.

The following methods are presently used to accomplish wastewater treatment at levels required by law:

- Secondary (biological) treatment by either
  - trickling filter
  - activated sludge
- Advanced waste treatment (nitrogen and phosphorous removal) by
  - nitrification
  - dentrification
  - phosphorous removal by metal salt (lime or ferric addition)
  - filtration
  - carbon absorption
- Physical-chemical treatment (equivalent to advanced waste treatment)

Capital and operating costs are high for all types of nutrient removal. In Massachusetts, treatment plants discharging to fresh waters must provide advanced waste treatment to accomplish high levels of BOD and nutrient removals due to the limited assimilative capabilities of the area's rivers. A minimum of secondary treatment is required for all treatment plants discharging to the marine environment. All of the methods presented above are capable of accomplishing appropriate removal levels for BOD, suspended solids, and where necessary, nutrients.

It is important to remember that wastewater treatment plants perform the exact same function as the natural environment in terms of waste reduction, assimilation and utilization with two major differences. First, they do it faster and second, they accommodate large, continuous waste flows which would overload and ultimately overwhelm the natural environment if discharged untreated.

This observation has caused several engineers and scientists to reevaluate traditional methods of treatment and disposal, resulting in the development of innovative treatment schemes which make use of the assimilative capacity of the natural environment without excessive reliance on the limited capacity of any one component of that environment, such as a river.

One such system involves primary treatment (solids settling) followed by sand filtration. Effluent from the sand filtration process can be collected and disposed of through diffuse dispersion into swamps and marshes. An optional component usually included in such a system is aeration to accelerate biological reaction and control odors.

Another innovative treatment system is known as the marsh-pond system. A flow through system of artificial ponds are constructed to provide detention periods of 15 to 25 days. Such systems have been shown to achieve virtually 100 percent removal efficiencies for BOD, solids and nutrients due to settling and biological activity.

These systems are currently being evaluated in pilot projects across the nation. Drawbacks include odor problems, limited flow capacity due to detention times and land area requirements, locational requirements in relation to ground and surface water supplies and adequate public health protection. Reports published on pilot studies have shown, however, that these problems can be overcome and that these systems could represent low cost methods of wastewater disposal in a safe and environmentally acceptable manner.

In addition to water-oriented effluent disposal techniques there are a number of land oriented alternatives which should be considered including spray irrigation, infiltration and percolation, and overland flow.

Of these systems, infiltration-percolation and spray irrigation have potential for application in Massachusetts. Due to available disposal locations and required land area for disposal, application is limited to fairly small-scale treatment operations. Selection of a land-oriented, as opposed to a water-oriented, disposal alternative is also heavily dependent on the character of the effluent. Municipal wastewater can contain not only domestic wastewater but industrial and commercial wastes also. The presence of metals, complex organic compounds and toxic materials plays a significant role in the selection of treatment and ultimate disposal practices.

3. Sludge

The selection of the most appropriate and cost-effective manner of sludge disposal is heavily dependent on the respective characters of the effluent and sludge following treatment. The composition of the sludge will dictate whether or not the sludge is suitable for reuse or disposal. Another important consideration is that more advanced wastewater treatment results in larger quantities of more complex sludges to treat.

Wet sludge is generally of the same consistency of untreated septage. As such, sludge must be conditioned, thickened and dewatered, prior to ultimate disposal. Conditioning and dewatering normally occur as regular processes at the treatment plant.

The alternative methods for disposal of dewatered sludge are similar to the methods described earlier under septage treatment. Disposal alternatives include direct landfill disposal or incinceration followed by disposal of ash residuals in a landfill. Other alternatives include use as fuel and land application.

The primary goal of sludge reuse in land application is to recycle the nutrients and organic matter contained in it in a cost-effective and beneficial manner. Land application alternatives for sludge are as fertilizer or as a soil conditioner. Following dewatering, sludge usually requires stabilization prior to use in either of the methods mentioned above. Sludge stabilization can be performed by anaerobic digestion, aerobic digestion or composting.

Properly conditioned and dewatered sludge also has potential as a fuel source. The organic solids which make up 60 to 80 percent of the sludge solids have a heat value of approximately 10,500 BTU/pound. One such product commercially available is known as "Eco-fuel."

As discussed in the section on septage, sludge utilization as fertilizer or compost is most appropriate for small-scale local and regional wastewater management systems, due to land area requirements and factors relating to sludge transport problems and costs.

B. SEPTIC SYSTEM MAINTENANCE

Preventive maintenance has long been recognized by commerce and industry as a critical component of system management. Many town departments utilize such programs to insure maximum equipment and building facility life. Boards of health exert desirable guidance through local health codes during installation of septic systems, and some provide homeowners with handbooks on recommended use and maintenance of septic tanks. However, it is surprising that few municipalities in the MAPC study area have adopted comprehensive inspection or maintenance programs for existing septic systems. Partly because legal responsibility for the system ceases with approval of the installation and transfers to the owner, towns have been reluctant to undertake strong preventative maintenance efforts. In addition, a comprehensive program will likely require simultaneous development of facilities to handle larger volumes of septage. Provisions for adequate septage disposal have been a major obstacle blocking implementation of local inspection/maintenance programs because septage treatment has proven both difficult and costly. Controlled blending of septage into existing sewage treatment plants if feasible but when treatment plants cannot accept more or are far from areas where septage originates, inadequate, sometimes illegal and environmentally dangerous disposal methods are commonly used.

Unquestionably, the owner of a septic system has responsibility to "keep the (house) sewers and disposal systems in proper operational condition and to have such works cleaned or repaired at such times as ordered by the Board of Health," (Section 2.19, Title 5, State Environmental Health Code). That code and many local codes also express clear preference for regulating preventative maintenance as in Section 6.16... "Septic tanks should be inspected and cleaned annually."

Unfortunately, whether due to poor installation, owner neglect, willful abuse, or "natural" factors, responsibility for solving many failures ultimately returns to the shoulders of public representatives. The weight of this responsibility is likely to grow. In many towns there are approximately ten systems in the ground now for every new system likely to be installed in the next decade. Existing systems are not only older, but commonly were installed under less stringent local regulations.

Inspection and maintenance programs will not eliminate all septic system failures. However, an I/M program will pay off with increased system efficiency and dependability, longer operating life and lowest overall wastewater disposal costs.

Owner or user education promotes awareness of system limitations and focuses attention on the owner's responsibility for conservative system use. Developing a septic system management program, even in areas with growing frequency of problems may meet with strong resistance if not preceded by sufficient effort showing benefits of regular attention. Coordinated, municipal programs will be viewed as a useful town service, rather than harassment, when citizens appreciate that regular inspection of existing systems:

- insures maximum system life expectancy of at least 25 years for half the population of first installations;

- insures minimum carry-over of solids from septic tanks to drainfield--a major cause of premature drainfield failures;

- insures earlier warning of impending problems and provides opportunity for on-site, professional advice and remedial action before irreparable damage is done to the drainfield;

- insures life expectancy of more than 20 years for half the population of second or replacement system;

- provides considerable site-specific knowledge of the causes of failure which is invaluable to town officials in assessing feasibility of more expensive methods of wastewater treatment in areas where chronic failures occur.

Inspection and maintenance - The objective of inspection is not merely measuring scum and sludge accumulation and determining whether cleaning is necessary; inspectors should be trained observers and teachers who also focus the attention of the owner on features that adversely affect system operation. An inspector can point out site characteristics such as drainage that could be improved by installing interceptors (curtain drains) upgradient from the drainfield. He might see that runoff from nearby roofs or paved surfaces could be excluded from a drainfield area with minor alterations of downspouts and runoff leaders. From town records of owners' water bills, the inspector can bring knowledge of the winter water consumption rate to each inspection. The use of a checklist of water-using devices would be valuable in assisting owners become aware that simple, inexpensive water conservation efforts in the house can be important factors in failure prevention programs. Garbage grinders are known to contribute to rapid build-up of solids in septic systems but other factors are also involved. On-going inspections will quickly establish the most reasonable cleaning frequency based on characteristics of individual systems.

In summary, a comprehensive inspection and maintenance program will concentrate much effort on teaching owners how to use their septic systems successfully. This program expands the concept of system maintenance beyond regular solids removal to include the prevention of future failures.

1. Inspection and Maintenance Programs

Preventing system failure is cheaper than solving problems after a long period of inattention. A comprehensive manage--ment program for existing systems should include registration, inspection and scheduled periodic maintenance of private disposal systems. Developing a program requires coordinated private and municipal effort. The three model programs described in this section have one factor in common - benefits of successful local cooperation and implementation accrue directly to those whose money supported the program.

A community can initiate an inspection/maintenance program by utilizing:

- a municipal inspection team with town ownership of septage pumping equipment and inspector's vehicles;
- a municipal inspection team with private ownership of septage pumpers;
- a private inspection team and privately-owned pumping equipment.

Costs of staffing and operating a program with full municipal control and equipment ownerships are shown in Table C-1 for a town with 3,000 existing septic systems.

Three full-time inspectors are adequate during start-up, fewer will be necessary once the program overcomes some initial barriers and each inspector completes more than the required two inspections per day. At this minimum rate, each system would be inspected once every 30 months. During the initial phase of the program, about one-half of the systems probably will require cleaning. Since the three inspectors will inspect only 1,200 systems per year to start, about 600 pumping jobs will be likely. Once the program is underway for three years, owners of septic systems will receive the following service and bills:

- costs of inpsection will be distributed equally among all owners; costs of pumping will be borne only by those whose systems require pumping;
- inspection--once every 30 months initially--decreasing to every 20 months and costing about $30 per year;
- cleaning--once every two to three years at $30 each job or $8 additional per year.

Charges for septic system pumping are separated from inspection costs and billed to owners whose systems require cleaning service. Pumping costs vary inversely with the number of systems pumped each year. Table C-2 shows costs ranging from $20 each if 1,000 systems are serviced to $50 per cleaning when annual service totals 400 jobs. With federal assistance in purchasing the pumper truck, costs decrease about 20 percent and range from $16 to $41 per job.

2. Municipal Inspection with Private Pumping Service

By utilizing services of private pumpers a town could avoid getting into the septage hauling business and perhaps take advantage of lower cost per pumping offered by an existing network of large private haulers. Private Massachusetts firms charge from $20 to $75 per pumping with most domestic jobs averaging about $30. Since costs of municipal inspection personnel would remain similar to those in the preceding program, the system owner will realize savings when private haulers can pump at lower costs than town operated units. Since town-owned pumpers are totally user-supported, municipal cleaning costs may exceed average private fees if less than 600 tanks are pumped annually.

Employing services of private firms cannot absolve local officials of responsibility for insuring that acceptable methods of disposal are used by haulers involved in a town supported maintenance program.

TABLE C-1
INSPECTION-MAINTENANCE PROGRAM
MUNICIPAL STAFF AND TOWN-OWNED SEPTAGE PUMPER *

Personnel - Inspection Team and Vehicles	Subtotal	Yearly Total
Chief inspector: one(1) @ $12,000	$12,000	$12,000
Assistant inspector: two(2) @ $10,500	21,000	21,000
Clerk-Secretary: one(1) @ $8,000	8,000	8,000
Vehicles - Inspection Team		
Three vehicles in use 200 days/yr. Debt service 6-year vehicle life		2,500
Operating, maintenance, insurance 15,000 mi. each yr. @ 0.15/mi.	6,750	6,750
		$50,250

SEPTAGE PUMPER UNIT

Personnel	Subtotal	Yearly Total
Operator-Driver (1) $10,000	10,000	10,000
Vehicle		
Pumping truck $20,000 - bond issue		
Amortization and debt (8% interest) service over 5 years	6,440*	6,440*
Truck operation, maintenance, insurance 15,000 mi/yr. @ $0.25/mi.	3,750	3,750
		$20,190

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* Source: MAPC Water Quality Project, May, 1977

* With federal repayment of 75% of purchase cost at 1/5 balance due per year, substract 3,750/year.........$16,44

TABLE C-2

SEPTIC TANK PUMPING COSTS

Number of Systems Serviced Annually	Approximate Cost to owner without Federal Assistance*	With Federal Assistance
400	$50	$41
600	$34	$27
800	$25	$21
1000	$20	$16

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* see Table C-1

3. Private Inspection and Privately-Owned Pumping Equipment

With policy support by local officials, an inspection and maintenance program could be designed to be run by private firms under contract to the town. However, inspection and pumping interests should be separate to avoid compromising the objectivity of inspectors.

C. LANDFILLS: WATER QUALITY IMPACTS AND SOLUTIONS

As discussed in Chapter 3, many landfills in the region do not generally meet state operating standards. Abandoned landfills in several communities are not capped and continue to release contaminated water to surface and groundwater bodies. The volume of solid waste generated in the region continues to grow, however, indicating that the problem is not likely to resolve itself without some action by the cities and towns.

The immediacy and the importance of the solid waste problem is generally recognized by local officials. Growth policy questionnaires recently completed by each municipality indicate an interest in regional solid waste management programs. Therefore, the need for prompt action regarding solid waste management seems clear and a number of different approaches available to communities are described in this chapter.

Among approaches toward a long-term solution to the solid waste problem is the formation of multi-town districts for the development and operation of regional landfill. Another possible solution is the network of regional resource recovery plants proposed by the Massachusetts Bureau of Solid Waste Disposal. These alternatives will be evaluated in this chapter after a discussion of the immediate problems involving landfills. Measures to protect water resources through landfill siting, operation, monitoring and closing will be presented with associated costs, where possible.

A. LANDFILL SITING REGULATIONS

The State's Department of Environmental Quality Engineering (DEQE) has authority under section 150A of Chapter 111 to regulate the siting, operation and maintenance of solid waste facilities. The local board of health must assign the sites of any facility for disposing refuse. Aggrieved parties may appeal to the DEQE. The assignment may be rescinded by the local board of health or by the DEQE if it is determined that the operation or maintenance of the facility is causing a nuisance or a danger to the public health.

State landfill regulations specify that facilities shall be located only at sites where the potential for air, land, and water pollution is minimal. Wetlands and floodplains are specifically excluded except where there is no alternate site and the effect on flooding and water pollution will not be significant. Public and private water supplies must be protected, and refuse must be placed no less than four feet above groundwater and 60 feet from surface water. Plan submissions to the DEQE must include detailed hydrogeologic investigations to assess groundwater conditions and on-site soil suitability for cover material.

While these siting regulations prohibit the selection of bad locations, they fall short of ensuring the selection of excellent sites which offer little or no potential threat to water quality and exceptional leachate attenuation characteristics.

For instance, while some authorities recommend that landfills not be established in sandy areas having rapid soil percolation rates, several new fills (Scituate and Rockland) have been located in such areas. Studies have proven that most pollution travels more rapidly and further in permeable soils, increasing the possibility that leachate may reach the groundwater system. Furthermore, use of the permeable on-site soil as cover will allow rainwater easy entry into the fill resulting in leachate generation.

Depending upon local surficial geology, exclusion of permeable sites from consideration in landfill location may preclude landfilling in certain towns due to the prevalence of permeable strata. In the absence of alternative sites, landfills on permeable material should be designed and constructed with systems to control leachate generation or migration or both. In the vicinity of an aquifer, groundwater monitoring should be conducted as a measure to ensure that leachate control systems are operating as planned. Control systems could include combinations of impermeable liners beneath and above the fill, leachate collection drains beneath the fill, or pumping and treatment of surface and groundwater. While these techniques may be effective, they substantially add to operating costs. Also, should a preventive system fail, a permeable soil site will offer little protection to surface and groundwaters, as coarse sand and gravel deposits provide little filtration or leachate constituents. In the absence of leachate collection systems, the minimum distance to groundwater in permeable soil should be increased. In new or existing sites, greater distances to groundwater may be achieved by installing subsurface drains upgradient of the fill. The drains will intercept the groundwater, resulting in lowered groundwater elevations beneath the fill.

The horizontal distance to flowing water-courses should also be increased from 60 feet, in the absence of leachate collection systems, to allow for leachate attenuation through deposition, oxidation and dilution.

Also, sites which drain into ponds or lakes should be prohibited unless leachate collection is provided. The quiescent water, slow re-aeration and long detention time characteristic of ponds makes them susceptible to oxygen depletion, eutrophication, sedimentation and discoloration due to leachate inflow.

B. LANDFILL OPERATING REQUIREMENTS: PROBLEMS AND COSTS

Prior to the passage of state landfill regulations (MGL Section 150A, Chapter 111), community refuse disposal often took place in open dumps with minimal operating costs. Submarginal lands (often wetlands) were used, no engineering plans or geologic surveys were prepared, and covering practices were often primitive. Equipment, labor and utility expenses were minimal. The costs of such operations were to public health and the environment. Rats, insects, fires and contaminated drainage were typically associated with these neglected open dumps.

Landfills must now comply with DEQE regulations which specify an engineered method of disposal designed to minimize water quality and public health problems.

The regulations require DEQE approval of the proposed use, the plans and the design data for the proposed facility. Plans must include a detailed geologic survey. The operator of the facility must spread and compact all refuse in less than two foot thick layers at slopes not greater than thirty degrees and must cover each layer with six inches of cover material each day and place an intermediate cover consisting of impervious material on the top and sides of the operation within one month after placing refuse on that portion of the fill. The operator must provide adequate drainage for the fill to minimize infiltration, prevent erosion and the collection of standing water. The completed landfill shall not interfere with the proper drainage of adjacent lands nor concentrate runoff waters on adjacent lands and shall be planted with vegetation to promote stabilization of the cover. The cover should be inspected during the first 12 months following placement of the final cover to discover and correct conditions leading to ponding and/or percolation of water due to cracking. Orders assuring compliance with these regulations may be issued by the commissioner of environmental quality engineering.

Conformance to state landfill regulations has imposed substantial new costs to landfill operations. For new facilities, the initial investment includes the cost of disposal land, planning and engineering, site development, facilities and equipment.

Roughly, one acre of land with a 15-ft. compacted lift of solid wastes will accommodate a population of 10,000 for a year. If additional lifts can be placed over the initial lift, the land requirement can be reduced. Since facility planning is customarily based on a twenty-year design life, a small community may require a 20-acre site, not including buffer zones, to meet its solid waste disposal needs. The initial investment for land which may range from $40,000 to $80,000 can be recovered in most cases on completion of the site through subsequent use of the land.

Other costs include the following:

- Planning and design costs which vary depending on the size of the site and the level of effort, but should be within $12,000 for a 20-acre site. Survey and geologic studies may add another $10,000.
- Litigation and prolonged hearings due to controversy surrounding a site may also be costly and cause long delays.
- Site development costs such as fencing, landscaping, drainage, access roads, clearing and filling are also variable, but may cost in the vicinity of $25,000.
- Facilities for a 20-acre site include utilities, fire protection, shelter and weight scales. Costs of these items at similar size sites elsewhere on on the order of $50,000.
- The primary piece of equipment required is a crawler/loader which may be purchased for approximately $75,000. Larger sites require larger, more expensive equipment.

The variability of initial costs from site to site is reflected by the wide range of estimates found in literature prepared by government agencies and consulting firms. A summary of these estimates follows.

Table C-3*

Summary of Landfill Development Costs
(in thousands)

	40-50 tons per day	100-250 tons per day	350-500 tons per day
Site Development, landscaping, buildings, scales, utilities, equipment & engineering	200-400	250-425	1,000-2,000

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* Table C-3 based on the following estimates of site development costs (in thousands) by size of facility in tons per day (TPD): 40 TPD-$172[7]; 50 TPD-$411[8]; 100 TPD-$372[9]; 150 TPD-$250[10]; 250 TPD-$425[11]; 300 TPD-$2,028[12]; 500 TPD-$1,300[13].

Actual operating costs of landfills in this region may be inferred by data collected in the Minuteman Solid Waste Region towns. Bedford and Burlington dispose of their refuse at a private landfill for approximately $10 per ton. Concord and Lincoln hire a private contractor to operate their town landfills and pay $10 and $8 per ton, respectively. Boxborough, which operates its own landfill, averages almost $9 per ton, and Sudbury, which operates a layer facility, spends just $5 per ton. Estimates appearing in solid waste literature (Table C-4) illustrate considerable economies of scale with increasing facility size and tonnage disposed. This is because landfills within a wide capacity range have similar expenses for many fixed cost items such as equipment, utilities, labor, administration, weight scales, access roads, etc. These costs do not increase in proportion to capacity, and therefore decline on a per ton basis with increasing capacity. Regional disposal sites serving several towns could offer substantial savings to member communities over the disposal costs of separate facilities in each town.

Table C-4

Summary of Landfill Operating Costs

Ton/Day	18[14]	33[15]	72[16]	100[17]	250[18]	500[19]
$/Ton	$8	$5.40	$4	$4.80	$2.30	$1.80

While these cost estimates do not assume uniform adherence to the state landfill code, it should be noted that many, if not most, landfills in the region are in violation of some aspect of the regulations. Operation in conformance with the code is, of course, more costly. Perhaps the most common violation is inadequate covering practices. The code specified that an impermeable cover be applied within one month after placing refuse in a portion of the fill. This practice prevents infiltration of rainwater and surface water into the fill which, in turn, minimizes leachate generation. Despite the importance of this practice to water quality protection, the expense of purchasing and applying a good, impermeable clay apparently discourages this practice.

An alternate impermeable covering practice is being evaluated at a 1,400 ton a day landfill in New Castle County, Delaware. Layers of a polypropylene sheet are used between lifts of milled trash. This system is reported to be one-third as expensive as using imported soil cover, although the need for milling the trash will certainly increase the overall expense.

To aid code enforcement, the DEQE should be allocated sufficient manpower and funds to ensure at least an annual inspection at each site. With present manpower restrictions, many landfills go uninspected for years, which leads to lax operating practices. An additional water quality impact assessment of each facility is discussed in the next section.

C. LANDFILLS AND WATER QUALITY

Action on water quality problems due to landfill leachates may be taken pursuant to the Massachusetts Clean Waters Act (MGL Chapter 21, Section 42). If the operation of a sanitary landfill is causing a discharge (direct or indirect) of any pollutant into the waters of the Commonwealth (including groundwater), then an enforcement action could be taken through the state attorney general. The owner/operator of the landfill could be liable for a fine of up to $25,000 for each day the violation recurs.

State landfill regulations specify an engineered method of waste disposal designed to minimize water quality impacts. Local adherence to this code is more costly than less rigorous operations, yet serves to protect local water resources. With increased DEQE enforcement activity, the future should see a more widespread adherence to landfill regulations. Subsequent sections of this report will deal with the measures and costs required to either upgrade existing operations to sanitary landfill status or to close them in an environmentally sound manner.

D. LANDFILL MONITORING

One of the basic objectives of a landfill monitoring program is to detect and evaluate potential or existing degradation of surface or groundwater caused by landfill leachate. Priority areas of investigation include assessment of landfill impacts on aquifers currently supplying drinking water and aquifers with good potential for future water supply. Also of concern are surface waters used for water supply or recreation which receive surface or subsurface discharge from landfill drainage.

Recommendations

- Each landfill in the state should be assessed by the DEQE for its likely impact on water resources. Present state inspections are infrequent and inadequate for water quality impact assessment. Site investigations should include collecting all existing information on site geology, soils and water resources.

- Site visits should be conducted to determine the leachate generation potential of the site as indicated by its size, depth, age, nature of waste, landfilling procedure and topography of the facility and its surroundings. Sites which do not drain primarily to the subsurface may exhibit visible surface leachate streams.

- Based upon the inventory of water resources and leachate generation potential, a preliminary site analysis should be conducted if it appears likely that valuable water resources are being contaminated or could be in the future. This analysis should include sampling of the surface water bodies and existing wells located near the site. Any surface leachate should be sampled and site vegetation should be examined for signs of stress. Surface drainage patterns during a rainfall should also be noted.

Landfill monitoring expenses would range from a few hundred dollars to a few thousand dollars per year depending upon the size of the landfill and the potential threat to public health. The assessment would require approximately five man days per site including search of office files and site visits. A team consisting of a geologist, a civil environmental engineer and a technical assistant would be required to conduct the program within each DEQE district.

If, in the process of field investigation, there is an indication (visual or sampled) of leachate contamination of surface waters, and if information about the subsurface geology indicates a valid need for groundwater monitoring, a monitoring requirement can be made a part of the enforceable administrative order. If needed, corrective action (including the possibility that the landfill may be closed) can subsequently be directed on the basis of groundwater quality obtained through sampling test wells as a result of the order.

Permit applications for new sanitary landfills may be approved subject to the condition of installing a groundwater monitoring system. Such a condition would be warranted for new facilities which offer the potential for groundwater contamination, as indicated by the required surficial geology information submitted with the engineering plans. The facility operator could then be required to file the results of quarterly tests to demonstrate that the landfill is operating as predicted and designed. These tests could be relatively inexpensive, being limited to an abbreviated list of key indicator parameters such as chlorides, specific conductance and dissolved solids. Evidence of leachate in samples would necessitate analysis of an expanded list of parameters.

The monitoring system required at old or new sites is variable, depending upon the landfill and aquifer characteristics. A minimal system would consist of roughly five, two-inch wells; one well upgradient from the landfill to determine background concentrations, one well within the landfill, and a line of three wells downgradient from the landfill situated perpendicular to the groundwater flow, penetrating the entire saturated thickness of the aquifer. Complex hydrogeologic environments would require a more elaborate monitoring network. The minimal system would cost several thousand dollars assuming required depths of less than 50 feet. A more complex situation could require a network of monitoring wells costing considerably more.

E. CLOSING OR UPGRADING EXISTING LANDFILLS

As previously discussed, most landfills in the study area are not in conformance with state landfill regulations. The nature of the operating deficiencies, together with the characteristics of the site determine the nature and extent of the facility's impacts on local land, air and water quality. The potentially detrimental effects of a poor landfill operation on ground and surface water quality include high biochemical and chemical oxygen demands, suspended and dissolved solids, hardness, chlorides, color, iron and other metallic irons and a low pH. Proper landfill siting, design and operation can minimize their effects.

Surface water protection - The pollution of surface waters by the operation of landfills generally results from either direct contact of the surface water with the residue or from contaminated groundwater which enters the surface watercourses. Of the two, the former is more prevalent and the easier to prevent. Ditches around the landfill area will intercept surface runoff from adjacent land areas and carry it around the landfill. If not intercepted, this surface water could flow onto the landfill surface, percolate through the residue layers, and exit as a contaminated leachate at the toe of the landfill. The landfill could also be blocking a natural drainage course, in which case the interrupted surface water would back up behind the landfill and gradually seep through the landfill to exit as a contaminated leachate on the downhill side. In either case, well designed and maintained ditches around the landfill operation during the initial, interim and final landfill stages will eliminate the tributary surface waters as a pollution hazard. Proper covering practices including impermeable, intermediate cover will eliminate precipitation as a major source of water entering the refuse. This cover must be graded at a minimum slope of two percent to promote runoff and avoid ponding on the surface of the fill. Refuse should also be well compacted to provide resistance to the movement of water through the fill.

In the past, marshes and wetlands were frequently chosen as disposal areas. In this case, water contact with the refuse is assured, resulting in long-term contamination of surface water. Although it is possible to collect and treat the contaminated water, it is usually more economical to remove the solid waste using draglines.

Groundwater protection - Landfills located within aquifer recharge areas also pose a potential threat to groundwater quality. If refuse is deposited below the water table, contamination of groundwater through direct contact with solid waste is likely. Remedial measures include removing the refuse or lowering the groundwater. Where important water supplies are involved, measures to intercept the plume of polluted groundwater may be required. Possible steps include installation of pumping wells directly beneath the landfill to reverse the hydraulic gradient or installation of a line of interceptor wells along the toe of the landfill to restrict movement of leachate away from the landfill. Either pumping alternative should be accompanied by sealing and grading the landfill surface to reduce leachate generation. Depending upon the costs and feasibility of remedial measures, it may be necessary to phase out the facility, properly close it and select a more hydrologically suitable site.

Installation of pumping wells can be a costly solution, particularly if the water table is deep below the surface and the subsurface strata is difficult to penetrate. Depending upon these variables, installation of an eight inch well to a depth of 60-80 feet may cost from $10,000 to $30,000. Several wells may be required if the leachate plume is particularly wide or the subsurface strata are not highly permeable.

New sites may first install an impervious cell liner made of asphalt, cement, clay, PVC or polyethylene. Since leaks could arise if leachate reacts with the liner, precautionary groundwater monitoring should be conducted and an underdrain system for leachate collection should be installed.

Leachate intercepted from the surface or subsurface must be treated before it can be released. This is the case even with release of effluent to sewers, unless there is sufficient dilution in the sewer system to render harmless the leachate metals which could upset the bacterial population of a secondary treatment plant if received in concentrated form. Without sufficient dilution, leachate would require expensive chemical treatment. Unfortunately, very little research has dealt with leachate treatment.

Upgrading facilities - Many landfills in the region require substantial physical improvements to upgrade their condition to sanitary landfill status. Among the most common improvements needed are construction of drainage ditches around the site and grading, compacting and sealing the landfill sides and surface to allow proper drainage. The short remaining life and high cost to upgrade many sites will make it uneconomic to upgrade and operate many of the facilities as sanitary landfills. In these cases, the disposal site should be closed. Closing procedures should include a rodent extermination program and application of a final cover of two feet of compacted and seeded earth. Gas venting should be provided if necessary. Much of the work required to upgrade a site to a sanitary landfill is also required to properly terminate a site. Grading, compacting, sealing and construction of drainage ditches is required for either result. An engineering survey of existing land disposal areas in 27 communities was conducted as a part of the Norfolk County Comprehensive Solid Waste Management Study in July 1974. The survey estimated that the average cost to properly close a facility (January, 1974 prices) was $77,000 from a range of between $15,000 to $160,000. Estimated costs to upgrade these same facilities to sanitary landfill status ranged from $65,000 to $165,000 and averaged $106,000. None of the closing or upgrading estimates included the costs of collecting or treating leachate. Requirement of such a system could substantially increase construction and engineering costs.

The wide range of these estimates indicates the variability of conditions found at sites in Norfolk County. However, the estimate may be considered representative of requirements in most other areas of the Boston metropolitan region.

Reuse of landfill sites - The ultimate use of a closed landfill site will also influence closing costs. In general, it is not advisable to construct buildings over a closed dump because this surface provides a poor foundation. Furthermore, gas from the decomposing waste may accumulate in explosive concentrations in or beneath buildings constructed on or adjacent to the fill. Playgrounds, golf courses and similar recreational facilities do not normally have to support appreciable concentrated loads and converted dumps are often used for these purposes, however, careful planning is definitely required. Maintenance costs may be greater for recreational areas constructed on dumps than on natural ground because of excessive and irregular settling and possible cracking of the cover material.

F. REGIONAL SANITARY LANDFILLS

At the state and regional levels, attempts to solve the solid waste disposal problem date back to 1951, when the Metropolitan District Commission (MDC) was directed to study the feasibility of regional incinerators. Five were recommended, but only one was built - a city owned and operated incinerator in Boston, now closed.

In 1965, Chapter 748 amended Chapter 40 Section 44A-K of the General Laws to give cities and towns authority to voluntarily form solid waste disposal districts, and in 1969, authorized such districts to issue bonds to finance solid waste disposal facilities. To date, few attempts have been made to utilize this authority.

In 1969, Chapter 834 amended Chapter 16, Sections 18-24A of the General Laws to establish a Bureau of Solid Waste Disposal within the Department of Public Works with authority to select sites, designate regional solid waste districts and contract for facilities for the purpose of construction of facilities.

In 1971, an amendment to Chapter 834 authorized the Bureau of Solid Waste Disposal to utilize 10 million dollars for studies and consultants, as well as for solid waste facilities. Authorization to assess cities and towns for their share of facility costs was defeated.

In 1972, a Solid Waste Management Study Report was prepared for BSWD which recommended a statewide network of regional landfill districts. Only one such operation has been formed in the state, serving the towns of Marion, Carver and Wareham.

Despite the considerable economic and environmental benefits of such a system, regional systems failed due to the difficulty of reaching inter-community agreements on disposal site location. Substantial local opposition would typically accompany the prospects of a facility in one town, receiving the refuse of several others along with the attendant trucks, noise, dust, etc. Much of the opposition was probably due to false anticipations of unsanitary conditions at a proposed site similar to those associated with the old open, burning dumps of past decades. While these sources of opposition to regional facilities still remain, the benefits are becoming ever greater. Town landfill costs continue to rise with code enforcement. As landfills are closed due to state action or capacity problems, it is becoming increasingly difficult for many towns to find an acceptable location for a new facility with the spread of development and the more stringent state site selection criteria.

Lacking a local or regional alternative, several communities in the Boston area have hauled part, or all, of their refuse to large private landfills in Plainville or Amesbury. This alternative is quite expensive with transportation and disposal costs of $17 per ton. Added to this cost is approximately $3 per ton for transfer of wastes and close to $10 per ton for collection.

The major advantage of the transfer-haul system to a remote private landfill is that all wastes are removed from the community without the problems associated with designating, operating and maintaining a disposal area. Also, contract negotiations are limited to the private landfill contractor, instead of with several other towns or the designated authority as would be the case with a public regional landfill. This arrangement also provides both short and long term options, allowing communities to select the time span most appropriate for them.

Besides the high expense of this arrangement, the primary disadvantage is that there are presently only a few contractors who could accept the wastes for even a five-year contract. As more towns make use of their limited facilities, their remaining operating life will shorten. Also, if during the contract period, the contractor was to go out of business or his facility was closed, the cities would face an immediate refuse disposal problem. These disadvantages can be overcome somewhat by including provisions in the contract to guarantee the financial resources of the contractor and to restrict the size of the operation to ensure a given remaining site life. Towns would still lack control over the operation of the facility and could not ensure compliance with laws and regulations. Water quality impacts associated with the disposal of a community's refuse may only be changed in location by the selection of the private landfill alternative.

Given the expense and the questionable future availability of the private landfill option and the expense and land requirements of individual town landfills, public regional landfills provide an alternative solution with considerable merit in areas where regional resource recovery facilities will be unavailable in the near future. Public education and economic incentives to those communities may dispel local opposition to these systems.

Some of the advantages of areawide cooperation include:

- Elimination of duplication in use of consultants for initial surveys;
- Greater flexibility in locating disposal sites;
- Greater discounts for volume orders of collection and disposal equipment and materials;
- Elimination of duplication of numerous facilities (shelters, utilities, scales) and site preparation items (roads, fences, etc.);
- Coordination of air and water pollution abatement activities;

- Better chance for federal assistance;
- Economies of scale in administration, land acquisition, and construction.

In short, regionalization can aid in reducing the unit costs while providing a higher quality operation meeting environmental standards. The larger area within which a site may be chosen increases the opportunities for selection of a site with low potential for water resource impacts without expensive leachate collection and treatment systems.

The landfill disposal cost figures presented in Table C-4 illustrate considerable economies of scale with increasing capacity in tons per day. These savings are somewhat offset by increased hauling distances from the point of collection to the disposal site. Multi-town facilities do not, however, increase haul distances to the same degree as some private landfill options which have, in the case of the Amesbury and Plainville sites, required 40 mile haulage for certain towns.

Regional landfill systems may require use of transfer stations for member towns distant from the disposal site. Depending upon the transportation network, transfer stations and trailer haul to the site offer lower net transportation costs for haul distances in excess of a certain number of miles (usually between 12 and 20) which differs in each area depending upon transportation time to the site.

Table C-5 presents a summary of estimated transfer station capital and operating costs for manual and unmanned stations.

Table C-5*

Costs for Transfer Stations

	Capacity (tons/day)	Capital Cost ($)	Operating Cost ($/ton)
Unmanned Station	1.1	14,500	9.42
	4.3	19,800	3.70
	7.2	27,900	3.00
	12.0	36,000	2.25
Manned Station	25	88,000	4.90
	50	120,000	3.10
	100	180,000	2.60
	500	340,000	1.05
	1000	470,000	0.75

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* Arthur D. Little, Co., "Opportunities for Regional Solid Waste Management," April, 1975.

As in the case with landfill disposal, there are considerable economies of scale in transfer station operation with increasing size.

The cost of trailer transport of compacted refuse from the transfer station to the disposal site is roughly estimated at $.08 per ton mile plus $.56 per ton for unloading. A 30-mile round trip at 30 miles per hour would therefore cost $2.96 per ton.

A multi-town regional landfill could be implemented through the "host town" concept or through the formation of a district under MGL Chapter 40, Section 44A-44K. The district would have the power to plan, take land by eminent domain, issue bonds, contract for waste disposal and to design, construct and operate solid waste facilities. The advantage of the district is that it can effectively coordinate the solid waste disposal of several communities, avoid duplication of effort, and take advantage of economies of scale. One major disadvantage is that it results in some loss of local control for each member community.

The "host town" concept involves the owning and operating of facilities by one community which contracts with other communities for the use of the facilities. The advantages are the simplicity and acceptability to other communities. The disadvantages are that an individual community would not have the same resources, such as bonding power, to finance a large multi-town facility. Also, the contracting communities would have no control over the operation and finances of the system.

A final possible management system would be for communities to work towards a regional resource recovery facility as provided for under the State Solid Waste Management Plan. This plan, and its advantages and disadvantages to communities with emerging solid waste disposal problems will be discussed in the next section.

G. REGIONAL RESOURCE RECOVERY

In 1974, the environmental reorganization under Chapter 806 of the Acts of 1974 resulted in the transfer of the Bureau of Solid Waste Disposal to the Department of Environmental Management (DEM). Subsequent studies by the BSWD documented increasing municipal disposal costs to meet stricter land disposal and incineration regulations imposed by the DEQE. Despite these costs and regulations, solid waste disposal was continuing to cause degradation of the land, air and water while wasting valuable energy and material resources contained in solid waste. As a result of these findings, the BSWD proposed a statewide solid waste management plan consisting of three large (3,000 tons/day) regional resource recovery plants and four smaller (1,500 tons/day) plants which would provide statewide coverage by the early 1980's. Implementation of this plan would take into consideration two privately constructed resource recovery plants - the RESCO plant in Saugus and the CEA plant in East Bridgewater. Both plants are expected to handle 1,200 tons/day of refuse with the possible expansion to 2,400 tons/day at the RESCO site.

The BSWD is currently sponsoring the implementation of two regional systems. The first, begun in 1974 in northeastern section of the state, has gone through regional organization, site selection and system procurement. The second, in the west suburban area of Boston, is currently in the organization and site selection phase.

The plan recommends that the resource receovery facilities be privately financed, constructed and operated. The BSWD funds the "front end" planning work necessary in assisting the communities in addressing the technical, institutional and financial implementation issues. This includes selection of the most appropriate system technology and the development of operational plans and procedures. In addition, BSWD seeks to determine economically sound regional configurations and to arrange for agreements for the delivery of solid waste to the facility.

Implementation activities include organization of the region, site selection, system procurement, contract negotiation and approval, financing, construction and start-up. The BSWD estimates that each regional system will take an average of five years to implement. Judging from the northeast and 128 west regions, this estimate is optimistic. Based on these estimates, implementation of statewide systems is forecast by the BSWD by the early 1980's. It is realized that this timetable hinges on the willingness of communities to join together in a regional approach to solid waste management.

Resource recovery plants process wastes to recover both energy and materials. Energy recovery consists of production of liquid, solid, or gas fuel or combustion of refuse to generate steam for direct use or for the generation of electricity. Materials recovered primarily include iron, aluminum and glass. Ancillary facilities for the system include transfer stations and landfills for residue disposal and emergency backup.

The most widely proven technology, steam generation in a water wall incinerator, can be used to generate electricity on the site or it can be piped to nearby users for heat, cooling or manufacturing processes. The advantages are the well proven technology and the marketable products which are recovered. The disadvantages include the need for a market in the vicinity of the operation, high capital cost, and the production of low-value material products. Steam generation for direct use is economically viable at 1,000 tons/day, assuming an adjacent user and no need for an auxiliary steam generator. Electricity generation requires larger plants for economic viability. The RESCO plant generates steam for direct use, and the proposed Northeast plant will generate electricity from steam.

Pyrolysis is the thermal composition of materials by application of heat in the absence of oxygen. Pyrolysis produces either a low-BTU gas or an oil-like liquid. The technology is relatively new and has not been demonstrated fully at commercial plant sizes (about 1,000 tons per day or larger). The product output of this process if flexible, the marketability is good, yet the product quality is uncertain.

The dry shredded fuel process was selected by the CEA plant in East Bridgewater. This technology has not been fully demonstrated, but offers potential in areas with high fuel costs and suitably designed boilers. It is believed to be more economically viable at smaller sizes (1,000 tons/day) than the electricity generation process.

Disposal cost estimates are difficult to generate because of the limited experience with resource recovery in this state. Also, disposal costs are truly specific to each plant, since markets, tonnages and regional configurations which determine costs are unique to each area. However, the limited experience gained from the RESCO and East Bridgewater sites, together with the estimates prepared for the proposed Northeast plant provide some indication of likely disposal fees.

The RESCO facility (1,200 tons/day) generates steam for direct use by the General Electric Riverworks plant in Lynn. Ferrous and non-ferrous metals are also reclaimed. Disposal fees to communities range from $11-$12 per ton for the original 20-year contracts to $15-$17 per ton for present spot deliveries. Five-year contracts for disposal now being offered range from $13-$15 per ton. These fees are higher than estimates for the state-sponsored facilities largely because the RESCO plant was privately financed and was constructed on speculation in advance of securing disposal contracts with towns. The speculative risk of this venture necessitated large per ton management fees to the investors which is reflected in the per ton disposal costs.

The East Bridgewater plant which was designed to produce dry fuel (Eco-fuel II) from 1,200 tons of refuse received per day is presently incinerating refuse without fuel recovery. The disposal fee of $10 per ton presently charged would presumably be reduced when fuel production begins since revenue from product sales could defray some of the costs of operation.

Disposal costs at the proposed steam-electricity plant are projected to range between $5-$12 per ton. The higher figure is the contractual maximum that could be charged and represents operation at 2/3 of the capacity of 3,000 tons/day. Given success in disposal contract negotiations to ensure operation at capacity, the disposal fee would decline to the low end of the range. The disposal fee formula is tied to fluctuations in the price of electricity and the costs of operation and maintenance. If the present trend of electricity price increases continues to exceed increases in cost indices, the disposal fee could conceivably decline below $5 per ton.

Implementation of regional resource recovery facilities requires the organization of a region sufficiently large to supply between 1,000 and 3,000 tons of refuse per day. The requisite size of such a region implies transfer and transportation costs considerably in excess of those of a regional landfill which can be economically operated at a smaller daily tonnage.

An analysis of transportation and processing costs at different system sizes for the northeast steam-electricity plant is presented in Table C-6.

Table C-6*

Processing and Transportation Cost Summary
(Dollars per Ton)

	1000 TPD	1700 TPD	3000 TPD
Processing	17.00	10.00	5.00
Transportation (transfer & haul)	.90	2.70	3.90
Total Processing and Transportation Costs	17.90	12.70	8.90

TPD = Tons per Day

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* Bureau of Solid Waste Disposal

These figures demonstrate the particular economies of scale of the steam-electricity process. Although transportation costs increase with size, processing costs decline more rapidly resulting in a net cost reduction with increasing size. The northeast project is proposing regional sharing of transportation costs to lower the net disposal fee by inducing more distant communities to join.

The impacts of a resource recovery facility may be inferred from the analysis of the proposed northeast project. As mandated by state law, the host town of the recovery plant receives $1 per input-ton payment in lieu of taxes. At a plant throughout of 1,000 tons per day, the annual royalty revenue to the host community is $310,000. At 1,700 TPD, the annual revenue equals $527,000.

Construction of a 3,000 TPD electric power generation facility would cost roughly $100 million and provide roughly 500-700 man years of construction labor over a 2-3 year construction period.

Depending on the process, some 50-100 permanent skilled operations labor jobs would be created.

Site development facilities such as access roads may enhance the value of adjacent industrial land. The plant itself would require between 15-30 acres, and the residue disposal area would require a total of 20 acres which could be divided over multiple sites.

The disadvantages include increased truck traffic in the area; for a 1,700 TPD facility, about 300 packer trucks would use the site each day. Siting and access provisions minimize this impact. Air emissions must meet state and federal standards. Water discharge is limited to cooling water. If the residue is landfilled, leachate containing metals can be a problem unless control measures are used. Use of the residue as a road base is a possibility.

Financing is accomplished through the host community's Industrial Development Finance Authority. Tax exempt bonds are issued on the ability of the project to produce revenues and not on the faith and credit of the host community.

Risks to communities are limited to guaranteeing waste deliveries and payments for disposal.

In summary, regional resource recovery provides an attractive, economical waste disposal alternative, particularly in urbanized areas where land is not available for landfilling and the density of development generates high waste tonnages within moderately sized regions.

D. STORMWATER RUNOFF

A. OVERVIEW AND GENERAL CONSIDERATIONS

Historically, storm sewers were installed to channel stormwater runoff away from structures and dwellings and off streets and highways to protect the public health and safety, to prevent property damage resulting from floods, vehicular accidents and to eliminate vectors for disease transport. Concern over the water quality impacts of runoff has surfaced within the last seven to ten years.

Stormwater runoff is a problem of increasing severity as it is essentially related to urbanization. Urban growth and development brings about changes in the hydrologic cycle. Increasing the area of impervious surface increases the rate of runoff. Pollution from runoff occurs when precipitation flushes the urban area and carries pollutants to receiving waters. As the surface is flushed, the polluted water flows overland to collection systems. Rainwater originating on land surface and rooftops collects and flows into the system of streets, gutters and drains where it becomes concentrated in the storm sewer system.

Considering the route runoff takes, it is not surprising that polluted runoff contains substantial amounts of organic material, inorganic solids, nutrients, heavy metals and microorganisms, which can have a significant impact on receiving water quality.

The total annual pollutant load in stormwater during wet weather can be greater than the annual pollutant load discharged from municipal waste treatment facilities during dry weather. This fact could preclude meeting water quality goals regardless of the degrees or types of treatment provided for dry weather wastewater flows.

The objective of stormwater management is to reduce the negative impact of runoff on water quality to an acceptable level at an acceptable cost. In order to fully comply with this objective, it is necessary to determine what constitutes an acceptable level.

Due to the lack of quantitative data on the quality of stormwater runoff as well as information on receiving water quality, determination of an acceptable level may be the most significant roadblock to the development of an effective stormwater management program. It should be noted that the state-of-the-art in stormwater management is still in its relative infancy. Therefore, the emphasis for control and management of stormwater runoff is on short-term "Best Management Practices" as opposed to structural solutions such as treatment and/or storage. In the meantime, efforts are being expended to collect and analyze wet weather data, to determine acceptable levels and to evaluate the need and cost-effectiveness of alternative structural solutions.

B. CONTROL ALTERNATIVES

Generally, the four areas where controls can be applied are:

1) Land surface: land use and erosion and sediment controls can be applied to prevent pollutant transport off the land surface.

2) Road surface: where street maintenance and street sweeping or vacuuming can be used to remove accumulated pollutants prior to entering the storm drain system.

3) In-system controls such as catch-basin cleaning and vacuuming or sewer flushing.

4) End of pipe controls such as storage and treatment, settling basins or routing to a treatment plant.

A program of Best Management Practices (BMP's) for stormwater management would most likely involve a combination of approaches from among the four presented. Type 1 controls, however, are more likely to be applied in newly developing areas or during future development where implementation coincides with design and construction of new facilities. As discussed earlier, Type 4 controls are generally regarded as long-term solutions pending evaluation of their cost-effectiveness. This leaves Type 2 and 3 controls for immediate and short-term implementation in stormwater management programs.

A further consideration is selecting BMP's for stormwater management is that runoff problems are amenable to multi-purpose solutions. A multi-purpose approach recognizes that water quality is an important consideration but not the only one. Erosion control, flood control, water supply enhancement, protection of public health, increased recreational opportunities and aesthetic amenities are also important beneficial impacts of runoff control and management.

The ultimate goal of stormwater management is to keep water in its basin of origin. One possible solution is to channel runoff from developed areas to areas suitable for groundwater recharge. This keeps water in its basin of origin, available for other uses such as water supply and maintaining and regulating stream flow. Publicly-financed abatement programs directed primarily toward water quality have been difficult to justify economically. The multi-purpose approach to stormwater runoff management allows linkages with other environmental management objectives and programs and promotes integrated, cost-effective solutions to a multi-faceted problem.

The key to the MAPC 208 stormwater management program will be the development of BMP programs representing the optimum combination of common sense and available public dollars. This can probably best be achieved by combining Type 1, 2 and 3 controls with multi-purpose projects together with a continuing program of technical assistance and public education beyond the 208 time frame.

The following table summarizes the range of both "Best Management Practices" and structural controls which constitute the current "state-of-the-art" in stormwater runoff management.[20]

MANAGEMENT ALTERNATIVES SUMMARY

Categories	Aesthetic benefits	Flow reduction/attenuation	BOD$_5$ reduction: 0-25%	25-50%	Over 50%	Suspended solids reduction: 0-25%	25-50%	Over 50%	Total coliform reduction: 0-25%	25-90%	Over 90%	Nutrient reduction: 0-25%	25-50%	Over 50%	Capital cost range,[b] $/acre: 0-10,000	10,000-50,000	Over 50,000	Capital cost range,[b] $/mgd design capacity: 0-25,000	25,000-50,000	Over 50,000	Typical components or remarks
SOURCE CONTROLS																					
Retention/detention		●	●			●			●			●			●						Land use planning, upstream impoundment, porous pavement
Enforced controls	●		●					●	●			●									Air pollution, erosion, chemical use.
Neighborhood sanitation	●		●			●	●		●			●									Street sweeping, solid waste management.
COLLECTION SYSTEM CONTROLS[c]																					
Sewer separation	●		●	●		●				●	●	●	●			●	●				May require separate treatment systems.
Sewer flushing and cleaning	●		●	●		●	●		●			●			d						To date generally limited to small pipelines or infrequent applications.
Improved regulators and tide gates	●	●	●			●			●			●			●						Positive control, increased diversion to treatment.
Remote monitoring with supervisory control	●	●		●		●	●			●			●		●						Provides storage, discharge options.
Fully automated control	●	●		●	●		●			●			●	●	●	●					Automates storage, discharge options.
STORAGE AND TREATMENT																					
Storage	●	●	●	●		●	●		●	●		●	●		●						Tunnels, quarries, basins.
Physical treatment with and without chemicals	●		●			●	●	●	●			●						●	●	●	Fine screening, microstraining, sedimentation filtration, dissolved air flotation, swirl/spiral separation.
Biological treatment					●			●		●	●		●						●	●	Contact stabilization, trickling filters, lagoons, rotating biological contactors. Generally associated with continuously operated plant.
Physical-chemical				●	●			●		●			●	●						●	Precipitation, filtration, adsorption, ion exchange, air stripping.
Disinfection											●				●			●			Chlorination, hypochlorination, ozonation, chlorine dioxide.
INTEGRATED SYSTEMS (Varies)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	Most common master plan approach.

[a] Details on specific alternatives may be found in Part III, "Management Alternatives and Technology." Although classifications are thought to be generally representative, significant departures may be expected on a limited application.

[b] ENR = 2000.

[c] Polymer addition to increase flow capacities by reducing line friction may also be considered. Generally it is a temporary measure.

[d] No large scale applications for cost assessment.

APPENDIX C: FOOTNOTES

[1] *MacGibbon v. Bd. of Appeals of Duxbury* (1970) 255 W.E. 2d 347, at 350.

[2] *MacGibbon* at 350.

[3] St. 1975 c. 808 S.9.

[4] *Castle Estates, Inc. v. Park and Planning Board of Medfield* 344 Mass. 329, at 334.

[5] *Fairhaven v. Planning Bd. of Barnstable* (1977) Mass. Appeals Ct. Adv. Sh. 284, 286.

[6] *Garabedian v. Water and Sewerage Bd. of Medfield,* 359 Mass. 404,406

[7] Raytheon Service Company, *Study of Solid Waste Disposal for Program Plan Development for the Commonwealth of Massachusetts*, May 15, 1972.

[8] U.S. Environmental Protection Agency, Office of Solid Waste Management Programs, *Decision Makers Guide in Solid Waste Management*, 1976.

[9] Camp, Dresser and McKee, Inc.,*Norfolk County Solid Waste Management Study*, 1974.

[10] U. S. Environmental Protection Agency, *Decision Makers Guide*.

[11] Camp, Dresser and McKee, Inc. *Norfolk County Study*.

[12] U.S. Environmental Protection Agency, *Decision Makers Guide*.

[13] Camp, Dresser and McKee, Inc.,*Norfolk County Study.*

[14] U.S. Environmental Protection Agency, *Decision Makers Guide*.

[15] Ibid.

[16] Ibid.

[17] Ibid.

[18] Camp, Dresser and McKee, Inc. *Norfolk County Study*.

[19] Ibid.

[20] Lager, John A. and William G. Smith, "Urban Stormwater Management and Technology, An Assessment," EPA-670/2-74-040, December, 1974.

APPENDIX E

THE FOLLOWING TABLES OF INFORMATION RELATE TO EXISTING STORMWATER FACILITIES IN THE LOWER CHARLES RIVER BASIN. THE MAPC STORMWATER STUDY IS DESCRIBED IN CHAPTER 3 SECTION B.

TABLE E-1

BELMONT: EXISTING STORMWATER SYSTEM

SYSTEM CODE	MAJOR DRAINAGE AREA	SYSTEM LOCATION FROM	SYSTEM LOCATION DISCHARGING TO	SYSTEM DRAINAGE AREA (ACRES)	SIZE OF OUTFALL PIPE (DIAMETER IN.)
A	Beaver Brook	Winter Street	Beaver Brook	566	60
B	Little River	Concord Avenue	Claypit Pond	926	13.5 ft x 5 ft
C		Brighton Street	Little Pond	591	11.3 ft x 5.1 ft

TABLE E-2

BOSTON: EXISTING STORMWATER SYSTEM

SYSTEM CODE	MAJOR DRAINAGE AREA	SYSTEM LOCATION		SYSTEM DRAINAGE AREA (ACRES)	SIZE OF OUTFALL PIPE (DIAMETER IN.)
		FROM	DISCHARGING TO		
A	Stony Brook	Vasser Street and Erie Street	Canterbury Branch of Stony Brook	870	120 x 102
B		Bald Knob Road	Stony Brook Conduit	2,840[1]	15 ft x 13 ft
C	Neponset River	Harvard Street and Cummins Highway	Neponset River	510	102 x 63
D		Capen Street	Neponset River	480	104 x 63
E	Charles River	Bellevue Street and Centre Street	Charles River	580	10.5 ft x 10.5 ft
F	Brook Farm Brook	Manthorne Road and Lagrange Street	Brook Farm Brook Tribuary of Charles River	470	10 ft x 6.7 ft
G	Charles Basin	Warren Street	Charles Basin	370	66
H		Gordon Street, Brighton and Harvard Avenue, Brookline	Charles Basin	440	90 x 84
I	Muddy River	Beacon Street	6.5-ft x 6.5 ft separate storm drain in Strathmore Road in Brookline	270	78 x 84

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[1] Includes drainage area of system designation A

TABLE E-2 (continued)

BOSTON : EXISTING STORMWATER SYSTEM

SYSTEM CODE	MAJOR DRAINAGE AREA	SYSTEM LOCATION		SYSTEM DRAINAGE AREA (ACRES)	SIZE OF OUTFALL PIPE (DIAMETER IN.)
		FROM	DISCHARGING TO		
J	South Bay	Government Center Waterfront Area	Boston Harbor	80	96 84 6 ft x 6 ft
K	Boston Harbor	Woodsworth Street and Valley Street	Boston Harbor	90	66
L	South Bay	Kneeland Street and Marginal Road, BRA South Cove Project area	54-in. combined sewer off Hudson Street	40	42 48
M		Harrison Avenue, Columbus Avenue, and Berkeley Street; BRA South End Project area	Roxbury Canal Conduit and Union Park Street Pollution Abatement and Flood Control Facility	500	72 48 42 84

TABLE E-3

BROOKLINE: EXISTING STORMWATER SYSTEM

SYSTEM CODE	MAJOR DRAINAGE AREA	SYSTEM LOCATION		SYSTEM DRAINAGE AREA (ACRES)	SIZE OF OUTFALL PIPE (DIAMETER IN.)
		FROM	DISCHARGING TO		
A	Sawmill Brook	Boylston Street	Hammond Pond	37	30
B		Woodland Road	Sawmill Brook	483[1]	72 x 85
C		Gerry Road	Sawmill Brook	103	63 x 42
D		Rangeley Road	Sawmill Brook	116	54
E	Muddy River	Village Brook - Pond Avenue	Muddy River	853	2-8 ft x 6.5 ft
F		Tannery Brook - Brookline Avenue	Muddy River	331	12 ft x 5.5 ft
G		Longwood Avenue Drain - MBTA tracks	Muddy River	162	5 ft x 5.5 ft
H	Charles River Basin	Soldiers Field Road	Charles River Basin	440	7.5 ft x 7 ft
I		Halls Pond drain - Storrow Drive	Charles River Basin	203	60

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[1] Includes area from A

TABLE E-4

CAMBRIDGE: EXISTING STORMWATER SYSTEM

SYSTEM CODE	MAJOR DRAINAGE AREA	SYSTEM LOCATION FROM	SYSTEM LOCATION DISCHARGING TO	SYSTEM DRAINAGE AREA (ACRES)	SIZE OF OUTFALL PIPE (DIAMETER IN.)
A	Charles River	Portland Avenue Bristol Street	90" combined sewer tributary to Cambridge marginal conduit with discharge to the Charles River at the Charles River Dam	263	52 x 60
B		Main Street	Charles River Basin	33	24 x 26
		Wadsworth Street	Charles River Basin		36 x 36
		Ames Street	Charles River Basin		24 x 26
C		Endicott Street	Charles River Basin	227	68 x 72
		Pleasant Street	Charles River Basin		60
D		Sparks Street	Charles River Basin	64	66
E	Little River	Rindge Avenue Ext.	Little River	277	72
F		Normandy Avenue	Little River	59	42 x 41
G		Blanchard Road	Little River	437	78

TABLE E-5

DEDHAM: EXISTING STORMWATER SYSTEM

SYSTEM CODE	MAJOR DRAINAGE AREA	SYSTEM LOCATION FROM	SYSTEM LOCATION DISCHARGING TO	SYSTEM DRAINAGE AREA (ACRES)	SIZE OF OUTFALL PIPE (DIAMETER IN.)
A	Charles River	Lyon Street	Charles River	6	15
B		Route 128 Interchange 58	Charles River	22	12,15,18
C		Route 128 Interchange 58	Charles River	7	15
D		Route 128	Tributary to Charles River	10	24
E		Route 128	Weld Pond	67	18
F		Route 128 Interchange 59	Lowder Brook	489	48
G		Bridge Street	Tributary to Charles River	11	12
H		Bridge Street	Tributary to Charles River	2	12

LEXINGTON: EXISTING STORMWATER SYSTEM

SYSTEM CODE	MAJOR DRAINAGE AREA	SYSTEM LOCATION		SYSTEM DRAINAGE AREA (ACRES)	SIZE OF OUTFALL PIPE (DIAMETER IN.)
		FROM	DISCHARGING TO		
A	Hobbs Brook-Cambridge Reservoir	Shade Street	Tributary of Cambridge Reservoir	33	18
B		Roosevelt Road	Tributary to Cambridge Reservoir	44	N/A
C	Trophet Swamp	Massachusetts Avenue	Tributary to Trophet Swamp	22	15
D		Massachusetts Avenue	Tributary to Trophet Swamp	8	18
E		Constitution Road	Tributary to Trophet Swamp	188[1]	36
F		B&M RR tracks	Tributary to Trophet Swamp	130	42
G		Reed Street	Tributary to Trophet Swamp	104	24
H	Vine Brook	Baskin Road	Vine Brook	27	21
I		Clarke Street	Vine Brook	29	15
J		Winthrop Road	Vine Brook	46	36
K		Massachusetts Avenue	Vine Brook	27	18

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[1] Includes area from C and D

TABLE E-6 (continued)

LEXINGTON: EXISTING STORMWATER SYSTEM

SYSTEM CODE	MAJOR DRAINAGE AREA	SYSTEM LOCATION		SYSTEM DRAINAGE AREA (ACRES)	SIZE OF OUTFALL PIPE (DIAMETER IN.)
		FROM	DISCHARGING TO		
L		East Street	Vine Brook	135	36
M		Turning Mill Road	Tributary to Vine Brook	51	30
N	Beaver Brook	Vallyfield Street	Tributary to Beaver Brook	68	42
O	Great Meadows	Sanderson Road	Munroe Brook	86	18
P		Bartlett Avenue	Munroe Brook	142	36
Q		Massachusetts Avenue	Mill Brook	48	30

TABLE E-7

LINCOLN: EXISTING STORMWATER SYSTEM

SYSTEM CODE	MAJOR DRAINAGE AREA	SYSTEM LOCATION		SYSTEM DRAINAGE AREA (ACRES)	SIZE OF OUTFALL PIPE (DIAMETER IN.)
		FROM	DISCHARGING TO		
A	Hobbs Brook - Cambridge Reservoir	Bedford Road	Hobbs Brook	37	21
B	Stony Brook	Trapelo Road	Unnamed Pond	31	12
C		Lincoln Road	Swamp tributary to Stony Brook	15	18
D	Sudbury River	Great Road	Tributary to Farrar Pond	8	15
E	Shawsheen River	Morningside Street	Elm Brook	29	12
F		Sunnyside Street	Elm Brook	19	12

TABLE E-8

NATICK: EXISTING STORMWATER SYSTEM

SYSTEM CODE	MAJOR DRAINAGE AREA	SYSTEM LOCATION		SYSTEM DRAINAGE AREA (ACRES)	SIZE OF OUTFALL PIPE (DIAMETER IN.)
		FROM	DISCHARGING TO		
A	Morses Pond	Eric Drive	Tributary to Morses Pond	15	21
B		Oak Street	Tributary to Morses Pond	20	24
C		Liberty Street	Tributary to Morses Pond	229	48
D		Emerson Road	Tributary to Morses Pond	15	15
E		Center Street	Tributary to Morses Pond	61	15
F		Terrace Road	Tributary to Morses Pond	11	15
G		MacArthur Road	Tributary to Morses Pond	83[1]	36
H		Route 9	Bogle Brook	28	24
I	Lake Cochituate	Campus Drive	Dug Pond	581	2-36
J		North Main Street	Lake Cochituate	88	36
K		North Main Street	Lake Cochituate	77	N/A

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[1] Includes area from F

TABLE E- 8 (continued)

NATICK: EXISTING STORMWATER SYSTEM

SYSTEM CODE	MAJOR DRAINAGE AREA	SYSTEM LOCATION FROM	SYSTEM LOCATION DISCHARGING TO	SYSTEM DRAINAGE AREA (ACRES)	SIZE OF OUTFALL PIPE (DIAMETER IN.)
L		Mill Street	Tributary to Beaverdam Brook	94	52 x 26
M		Possum Hollow Lane	Lake Cochituate	30	24
N		North Main Street	Lake Cochituate	94	48

TABLE E-9

NEEDHAM: EXISTING STORMWATER SYSTEM

SYSTEM CODE	MAJOR DRAINAGE AREA	SYSTEM LOCATION FROM	SYSTEM LOCATION DISCHARGING TO	SYSTEM DRAINAGE AREA (ACRES)	SIZE OF OUTFALL PIPE (DIAMETER IN.)
A	Charles River	Wildwood Drive	Detention Pond	79	30
B		Wildwood Drive	Detention Pond	65	30
C		Dedham Avenue	Alder Brook	223	42
D		Glenwood Road	Alder Brook	139	36
E		Ivy Road	Tributary to Needham Reservoir	274	48
F		Charles Street	Charles River	203	48
G	Rosemary Lake	Chestnut Street	Tributary to Rosemary Lake	22	12
H		Marked Tree Road	Tributary to Rosemary Lake	247	48
I		Great Plain Avenue	Tributary to Rosemary Lake	24	12

TABLE E-10

NEWTON: EXISTING STORMWATER SYSTEM

SYSTEM CODE	MAJOR DRAINAGE AREA	SYSTEM LOCATION FROM	SYSTEM LOCATION DISCHARGING TO	SYSTEM DRAINAGE AREA (ACRES)	SIZE OF OUTFALL PIPE (DIAMETER IN.)
A	Charles River	Needham Street	Charles River	252	N/A
B	Charles River Basin	Laundry Brook	Charles River Basin	2,797[1]	7 ft x 10 ft
C		Hyde Brook	Charles River Basin	414	60 x 66

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[1] A portion of flow from an additional 172 acres around Hammond Pond might be introduced during storm conditions.

TABLE E-11

WALTHAM: EXISTING STORMWATER SYSTEM

SYSTEM CODE	MAJOR DRAINAGE AREA	SYSTEM LOCATION		SYSTEM DRAINAGE AREA (ACRES)	SIZE OF OUTFALL PIPE (DIAMETER IN.)
		FROM	DISCHARGING TO		
A	Hobbs Brook - Cambridge Reservoir	Route 128	Cambridge Reservoir	15	15
B	Beaver Brook	Lakeview Avenue	Hardys Pond	28	24
C		Lakeview Terrace	Hardys Pond	13	30
D		Newton Street	Charles River	270	2-6 ft x 10 ft
E	Charles River	Prospect Street	Charles River	476	4.8 ft x 6 ft
F		Maple Street	Charles River	67	18 24
G		Cooper Street	Charles River	77	18
H		Elm & Common Streets	Charles River	156	36 48
I		Farwell Street	Charles River & Walkers Pond	135	42 15

TABLE E-12

WATERTOWN: EXISTING STORMWATER SYSTEM

SYSTEM CODE	MAJOR DRAINAGE AREA	SYSTEM LOCATION		SYSTEM DRAINAGE AREA (ACRES)	SIZE OF OUTFALL PIPE (DIAMETER IN.)
		FROM	DISCHARGING TO		
A	Charles River	Pleasant Street	Charles River	79[1]	60
B		Rosedale Street	Charles River	193	54
C		Howard Street	Charles River	52	24
D	Charles River Basin	Spring Street	Charles River Basin	702	11 ft x 6 ft
E		Arsenal Street	Charles River Basin	846	60

TABLE E-13

WELLESLEY: EXISTING STORMWATER SYSTEM

SYSTEM CODE	MAJOR DRAINAGE AREA	SYSTEM LOCATION FROM	SYSTEM LOCATION DISCHARGING TO	SYSTEM DRAINAGE AREA (ACRES)	SIZE OF OUTFALL PIPE (DIAMETER IN.)
A	Morses Pond	Weston Road	Boulder Brook	55	NA
B	Fuller Brook	Sagamore Road	Abbotts Pond	51	"
C		Washington Street	Fuller Brook	108[1]	"
D		Penn Central Railroad Tracks	Tributary to Fuller Brook	406	"
E	Charles River	Bradford Road	Tributary to Charles River	70	"
F		Route 9	Tributary to Charles River	119	"
G		Industrial Park	Charles River	35	"
H	Rosemary Brook	Standish Circle	Longfellow Pond	31	"
I		Pricilla Road	Longfellow Pond	42	"
J		Route 9	Rosemary Brook	87	"
K		Housing Project	Rosemary Brook	13	"
L	Hurd Brook	Route 9	Hurd Brook	36	"

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[1] Includes area from B

TABLE E-14

WESTON: EXISTING STORMWATER SYSTEM

SYSTEM CODE	MAJOR DRAINAGE AREA	SYSTEM LOCATION		SYSTEM DRAINAGE AREA (ACRES)	SIZE OF OUTFALL PIPE (DIAMETER IN.)
		FROM	DISCHARGING TO		
A	Stony Brook	Myles Standish Road	Tributary to Stony Brook	100	18
B		Viles Street	Stony Brook	33	12
C		Wellesley Street	Tributary to Stony Brook	63	18
D	Charles River	Oxbow Road	Charles River	72	24
E	Nonesuch Pond	Pelham Road	Tributary to Nonesuch Pond	52	18
F		Wellesley Street	Tributary to Nonesuch Pond	155	24

TABLE E-15
HYDROLOGIC PARAMETERS

COMMUNITY	SYSTEM CODE	1975 Cv	1975 DESIGN SYSTEM VOLUME	1975 TREATMENT RATE	1995 Cv	1995 DESIGN SYSTEM VOLUME	1995 TREATMENT RATE
BELMONT	B	.521	5.29	2.00	.539	5.48	2.07
	C	.469	2.75	1.04	.446	2.91	1.10
	G	.524	2.64	1.98	.533	2.70	1.02
CAMBRIDGE	E	.416	.463	.175	.531	.592	.224
	F	.557	2.44	.922	.563	2.46	.931
LEXINGTON	H	.600	.204	.077	-	NC	-
	I	.569	.225	.085	-	NC	-
	J	.582	.427	.161	-	NC	-
	K	.375	.214	.081	-	NC	-
	L	.348	.586	.284	.438	.738	2.79
	UV	.464	5.97	2.26	.505	6.51	2.46
NEWTON	A	.562	1.72	.835	.630	1.92	.724
	C	.624	3.56	1.35	-	NC	-
WALTHAM	F	.599	.772	.292	-	NC	-
	G	.600	.677	.256	-	NC	-
	I	.608	1.36	.515	-	NC	-

POLLUTION LOADING

COMMUNITY	SYSTEM CODE	1975		1995	
		BOD$_5$	SS	BOD$_5$	SS
BELMONT	B	43.7	1770.	43.7	1870.
	C	25.3	1060.	27.0	1130.
	G	22.3	898.	22.8	918.
CAMBRIDGE	E	13.3	233.	4.53	187.
	F	20.0	833.	70.3	843.
LEXINGTON	H	1.88	75.	-	-
	I	2.07	84.	-	-
	J	3.78	150.	-	-
	K	1.59	63.	-	-
	L	4.22	191.	7.25	318.
	UV	48.8	2000.	54.0	2120.
NEWTON	A	14.0	571.	16.1	627.
	C	29.3	988.	-	-
WALTHAM	F	4.67	108.	-	-
	G	4.42	204.	-	-
	I	9.10	277.	-	-

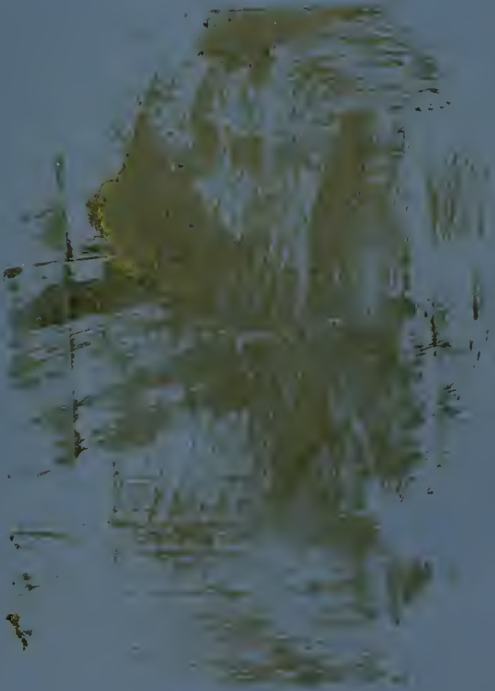
TABLE E-17
STRUCTURAL ALTERNATIVES - CAPITOL COSTS

COMMUNITY	SYSTEM CODE	SWIRL CONCENTRATOR	SEDIMENTATION	DISSOLVED AIR FLOATATION	FLOCCULATION SEDIMENTATION	FILTRATION	DISINFECTIONS
BELMONT	B	962,200.	1,621,900.	1,960,500.	1,764,000.	1,988,700.	103,600.
	C	629,600.	1,113,800.	1,325,700.	1,210,300.	1,351,000.	93,100.
	G	598,600.	1,065,100.	1,265,600.	1,157,200.	1,290,300.	92,200.
CAMBRIDGE	E	220,400.	437,100.	504,100.	473,900.	516,800.	82,600.
	F	563,300.	1,009,000.	1,196,500.	1,096,000.	1,220,500.	91,200.
LEXINGTON	H	110,500.	235,400.	267,100.	254,000.	273,900.	80,400.
	I	117,700.	249,200.	283,100.	269,000.	290,400.	80,500.
	J	177,900.	360,800.	413,800.	390,200.	424,400.	81,700.
	K	114,100.	242,200.	275,000.	261,500.	282,100.	80,500.
	L	254,400.	497,000.	575,300.	538,300.	589,500.	83,300.
	UV	1,081,200.	1,798,000.	2,183,200.	1,956,900.	2,211,300.	107,600.
NEWTON	A	476,600.	869,800.	1,025,800.	944,300.	1,047,700.	88,800.
	C	721,900.	1,257,000.	1,504,100.	1,367,200.	1,530,800.	95,900.
WALTHAM	F	262,100.	510,300.	591,300.	552,800.	605,800.	83,500.
	G	240,500.	472,600.	546,300.	511,700.	559,900.	83,000.
	I	380,500.	711,700.	833,500.	772,000.	852,500.	86,300.

TABLE E-18

STRUCTURAL ALTERNATIVES - OPERATIONS AND MAINTENANCE COSTS

COMMUNITY	SYSTEM CODE	SWIRL CONCENTRATOR	SEDIMENTATION	DISSOLVED AIR FLOATATION	FLOCCULATION SEDIMENTATION	FILTRATION	DISINFECTIONS
BELMONT	B	33,400.	48,600.	58,100.	54,200.	78,000.	5,000.
	C	29,400.	35,100.	41,800.	39,400.	63,000.	3,300.
	G	29,000.	33,900.	40,400.	38,100.	61,700.	3,200.
CAMBRIDGE	E	23,000.	20,700.	24,000.	23,000.	46,300.	1,200.
	F	28,600.	32,600.	38,800.	36,600.	60,200.	3,000.
LEXINGTON	H	21,600.	17,300.	19,500.	18,900.	42,100.	600.
	I	21,800.	17,600.	19,800.	19,200.	42,400.	700.
	J	22,900.	19,400.	22,300.	21,400.	44,700.	1,000.
	K	21,700.	17,400.	19,700.	19,000.	42,200.	700.
	L	24,200.	21,800.	25,400.	24,300.	47,700.	1,400.
	UV	34,800.	53,700.	64,200.	59,800.	83,600.	5,600.
NEWTON	A	27,400.	29,400.	34,900.	33,000.	56,500.	2,500.
	C	30,000.	38,700.	46,200.	43,400.	67,000.	3,800.
WALTHAM	F	24,300.	22,100.	25,700.	24,600.	48,000.	1,400.
	G	24,000.	21,400.	24,800.	23,800.	47,100.	1,300.
	I	26,100.	27,000.	30,700.	29,200.	52,600.	2,100.



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